

**ISO TC 184/SC4/WG3 N864****Date:** 2000-02-10**Supersedes ISO TC 184/SC4/WG3 N793****ISO/WD 10303 – 226****Standard title: Industrial automation systems and integration -****Series title: Product data representation and exchange -****Part title: Part 226: Application Protocol: Ship Mechanical Systems****COPYRIGHT NOTICE:**

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**ABSTRACT:**

This document represents the Committee Draft for Comment version of ISO 10303 Part 226 that deals with ship mechanical systems data representation for the purpose of electronic data interchange. Ships mechanical systems, within the scope of this standard, include ship's propulsion systems, auxiliary systems and deck machinery systems, together with their components. Product data pertaining to all lifecycle phases of ship mechanical systems are in the scope of this standard. The lifecycle phases covered include specification, selection, installation, commissioning, operation, in-service inspection, maintenance and decommissioning.

**KEYWORDS:**

application protocol; ship equipment; ship machinery; ship mechanical systems; ship propulsion system; ship auxiliary systems; lifecycle; mechanical product.

**COMMENTS TO READER:**

This is the fifth Working Draft of AP226 and contains all the major amendments due to the international industrial review of previous Working Drafts. The resolution of issues relating to collaborative use of ISO 13584 – Part 42 within this part of ISO 10303 has been included in this Working Draft.

This Working Draft will be used as the basis for interpretation of AP226 and preparation of the Committee Draft of this standard.

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## Foreword

ISO (International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body, interested in a subject for which a technical committee has been established, has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75% of the member bodies casting a vote.

International Standard ISO 10303-226 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration, Subcommittee SC4, Industrial data*. Many organisations have contributed and sponsored the development of this standard through various projects. The contributions of the following are acknowledged:

- **ShipSTEP:** A European industry funded project, ran from 1994 to 1996, with 8 European companies contributing to the development of shipbuilding Application Protocols.
- **EMSA** (European Marine Step Association): EMSA was founded in 1995 to co-ordinate European Marine Step developments and embraces the main European Shipbuilders, Classification Societies and marine software vendors.
- **NIDDESC II** (Navy Industrial Digital Data Exchange Standards Committee): The USA Navy Industrial Digital Data Exchange Standards Committee was formed in 1986 as a cooperative effort by the Naval Sea Systems Command (NAVSEA) and the National Shipbuilding Research Program (NSRP) to collect and exchange information on product model data requirements and to ensure that benefits expected by industry and Navy are incorporated into national and international data exchange standards. The NIDDESC effort has resulted in the development of a suite of product model data exchange specifications. These exchange specifications have been submitted to the ISO TC184 SC4 in 1993 for inclusion in the series of ISO 10303 application protocols, which form the ship product model data.
- **EDIMAR** (Electronic Data Interchange in the European MARitime Industry): European Union funded project, ran from 1997 to 1998, with 11 European companies contributing to the development of the shipbuilding aspects of AP226.
- **AP226 EWGs** (Expert Working Groups): Many organisations have contributed to this part through active participation in AP226 EWGs within which the application experts' view and consensus were sought with regard to industry requirements. These EWGs had a significant level of e-mail discussion on related issues and also held formal workshops.
- **MOSys** (Models for Operational Reliability, Integrity and Availability Analysis of Ship Machinery Systems): European Union funded project, ran from December 1997 to November 2000, with 8 European companies contributing to the development of the ship operation aspects of AP226.

## Introduction

ISO 10303 is an International Standard for the computer-interpretable representation and exchange of product data. The objective is to provide a neutral mechanism capable of describing product data throughout the life cycle of product and independent from any particular system. The nature of this description makes it suitable not only for neutral file exchange, but also as a basis for implementing and sharing product databases and archiving.

This International Standard is organised as a series of parts, each published separately. The parts of ISO 10303 fall into one of the following series: description methods, integrated resources, application interpreted constructs, application protocols, abstract test suites, implementation methods and conformance testing. The series are described in ISO 10303-1. This part of ISO 10303 is a member of the application protocol series. This part of ISO 10303 specifies an application protocol (AP) for the exchange of data pertaining to all life-cycle phases of ship mechanical systems.

The principal focus of this part of ISO 10303 is:

- Ship propulsion system including main engine, propulsor and shafting systems.
- Auxiliary systems including fuel oil, lube oil, power generation, cooling water system, and steam generation systems.
- Deck machinery including cranes, derricks and winches.

This application protocol is one of the series of ship product application protocols as shown in Figure 1. The series of ship industry application protocols assumes that the ship product model can be divided into separate ship systems that each covers a key element of the ship for its whole life cycle. These key elements are:

- ship moulded forms;
- ship arrangements;
- ship distribution systems (piping, heating, ventilation and air conditioning, as well as electrical and cableway);
- ship structures;
- ship mechanical systems;
- ship outfit and furnishings;
- ship mission systems.

Each separate system is described by one or more different application protocols. The full series of shipbuilding application protocols is depicted in Figure 1.

The information requirements for ship mechanical systems have been organised in a series of units of functionality (UoF). Figure 2 shows the units of functionality for this part of ISO 10303 in the form of AP226 data planning model. For further introductory information of STEP, AP226 and its data planning model, please refer to annex L.

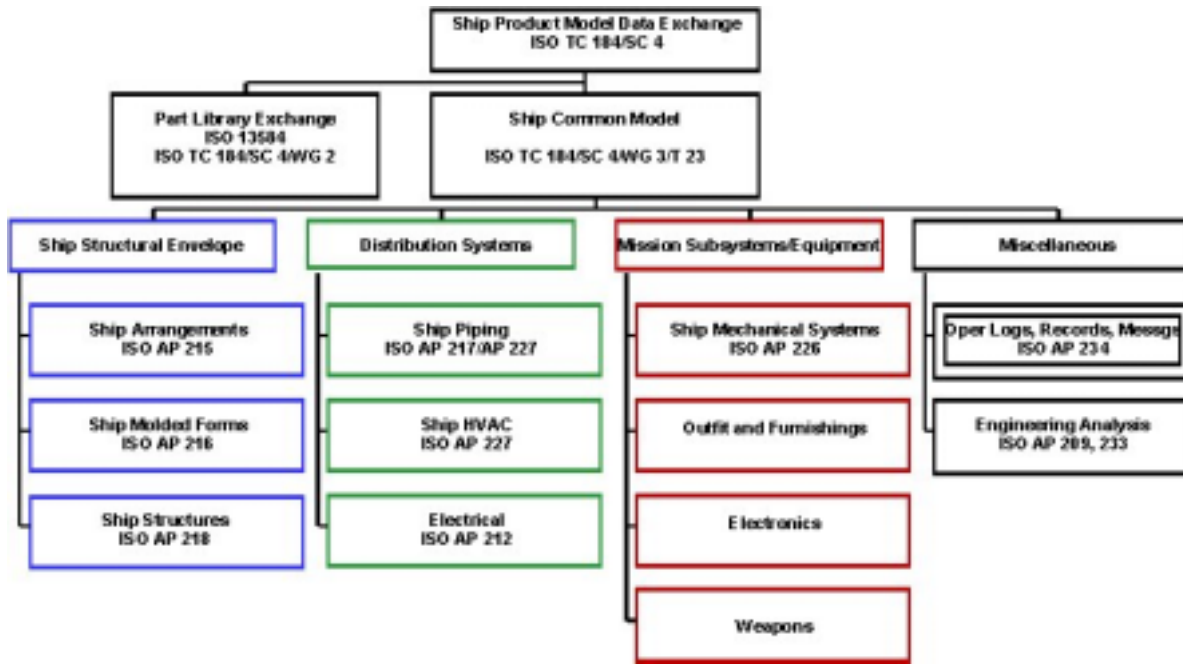


Figure 1 - Ship product application protocols

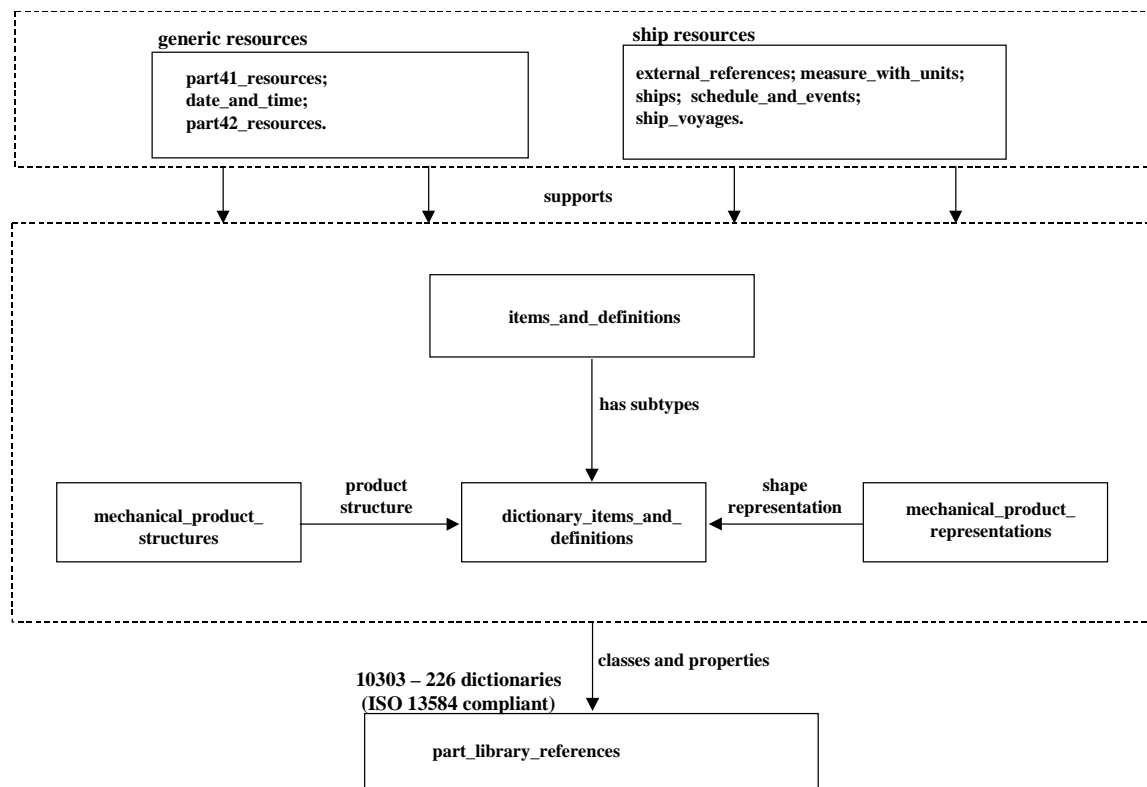


Figure 2 - AP226 Data Planning Model

This part supports and interacts with the following parts of ISO 10303.

**ISO 13584:** parts library

AP226 supports external references to classes defined by ISO 13584. This part of ISO 10303 supports the exchange of standard parts catalogues used to define specific items within ship mechanical systems. A standard parts catalogue may be exchanged as part of a design, or referenced by a customer to a contractor in order to specify the standard parts that shall be used.

**ISO 10303-221:** Application Protocol: Functional data and their schematic representation for process plant.

This part of ISO 10303 supports external references to classes of properties defined by ISO 10303-221.

**ISO 10303-215:** Application protocol: Ship Arrangements

**ISO 10303-216:** Application protocol: Ship Moulded Forms.

**ISO 10303-217:** Application protocol: Ship Piping Systems.

**ISO 10303-218:** Application protocol: Ship Structures

This part of ISO 10303 is interoperable with the above application protocols within the context of ship common model.

Application protocols provide the basis for developing implementations of ISO 10303 and abstract test suites for the conformance testing of AP implementations.

Clause 1 defines the scope of the application protocol and summarises the functionality and data covered by the application protocol. Clause 2 provides a list of normative references. Clause 3 lists the vocabulary defined in this part of ISO 10303 and gives pointers to vocabulary defined elsewhere. An application activity model that is the basis for the definition of the scope is provided in annex F. The information requirements of the application are specified in clause 4 using terminology appropriate to the application. A graphical representation of the information requirements, referred to as the application reference model (ARM), is given in annex G.

Resource constructs are interpreted to meet the information requirements. This interpretation produces the application interpreted model (AIM). This interpretation, given in clause 5.1, shows the correspondence between the ARM and the AIM. The short listing of the AIM specifies the interface to the integrated resources and is given in clause 5.2. Note that the definitions and EXPRESS provided in the integrated resources for constructs used in the AIM may include select list items and subtypes which are not imported into the AIM. The expanded listing given in annex A contains the complete EXPRESS for the AIM without annotation. A graphical representation of the AIM is given in annex H. Additional requirements for specific implementation methods are given in annex C.





# **Industrial automation systems and integration - Product data representation and exchange - Part 226: Application Protocol: Ship Mechanical Systems**

## **1 Scope**

This part of ISO 10303 specifies the use of the integrated resources necessary for the scope and information requirements for the exchange of ship mechanical systems information.

NOTE the Application Activity Model (AAM) in Annex F provides a graphical representation of the processes and information flows which are the basis for the definition of the scope of this part of ISO 10303.

The following are within the scope of this Part of ISO 10303:

- the representation of the mechanical systems and their principal components for both naval and commercial ships;
- the product definition data pertaining to the following lifecycle phases of the ship mechanical systems:
  - specification;
  - design/selection;

NOTE the design data will be supported for those components that are designed and manufactured within the context of marine industry as shown in AAM (Annex F). For example, data necessary to design a diesel engine will not be supported while data required to design a marine propulsor will be supported.

- approval;
  - installation;
  - commissioning/acceptance;
  - operation;
  - in-service inspection and maintenance;
  - decommissioning/disposal.
- the product definitions of the following mechanical systems:
  - the components in the systems that supply air to the engine room such as engine room ventilation fans and exhaust gas system such as silencers, economiser and so on.
  - the components in the fuel oil treatment and supply systems, engine lubricating system and engine cooling system.
  - the propulsion system: including main engines, shafts, couplings, gearing and propulsor;

- the manoeuvring system, consisting of the rudder, stock and actuator; thrusters including azimuthing thrusters; hydroplanes stock and actuator; stabilisers; cycloidal propeller type units; pivoting nozzles and water jet type systems.
- the power systems including electric propulsion and auxiliary electrical generation;
- the product definitions of the following mechanical components:
  - pumps necessary for the operation of the main propulsion and essential machinery such as boiler feed, condensation extraction, fuel oil pumps, lubricating oil pumps and cooling water pumps.
  - the auxiliary machinery such as heat exchangers, air compressors and air receivers;
  - boilers;
  - auxiliary engines and thruster units;
  - deck machinery such as windlasses, winches, capstans, general purpose cranes and derricks;
- the distinction between the physical specifications and the functional specifications of various systems and components.
- the following product definition information:
  - the functional and physical connectivity between components and between systems including physical connectivity of equipment to ship structure;
  - functional description of components and systems such as performance and operational characteristics;
  - geometric representation of systems and components to a level compatible to lifecycle phases of the corresponding system and component;
  - technological information such as material, tolerance, noise, vibration, shock and stress characteristics;
  - data that are necessary for tracking a component's lifecycle and operational history such as specification, in-service inspection and maintenance data.

The following are outside the scope of this Part of 10303:

- the product definition data and physical connectivity pertaining to the following components and systems including:
  - the piping arrangements not integral to the machinery unit;
  - the electrical distribution systems not integral to the machinery unit;
  - the control systems not integral to the machinery unit;
  - the nuclear steam raising plant;
- maintenance equipment such as cranes, tools and so on;

- the ship's arrangement and compartmentation;
- the ship's Heating, Ventilation and Air Conditioning (HVAC) systems;
- the mission specific mechanical systems of the ship including:
  - cargo refrigeration
  - naval military equipment
- the outfitting of the ship, including hatch covers, watertight doors, fire fighting appliances, anchor and chain cables, davits and lifesaving appliances, sewage systems;
- data relating to the manufacture of the components.

## 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 31:1994, *Quantities and Units*.

ISO 1000:1992, *SI units and recommendations for the use of their multiples and of certain other units*.

ISO 8824-1:1994, *Information Technology — Open Systems Interconnection — Abstract Syntax Notation One (ASN.1) — Part 1: Specification of Basic notation*.

ISO 10303-1:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 1: Overview and fundamental principles*.

ISO 10303-11:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 11: Description methods: The EXPRESS language reference manual*.

ISO 10303-21:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 21: Implementation methods: Clear text encoding of the exchange structure*.

ISO 10303-31:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 31: Conformance testing methodology and framework: General concepts*.

ISO 10303-41:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 41: Integrated generic resources: Fundamentals of product description and support*.

ISO 10303-42:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 42: Integrated generic resources: Geometric and topological representation*.

ISO 10303-43:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 43: Integrated generic resources: Representation structures.*

ISO 10303-44:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 44: Integrated generic resources: Product structure configuration.*

ISO 10303-45: 1994, *Industrial automation systems and integration — Product data representation and exchange — Part 45: Integrated generic resources: Materials.*

ISO 10303-46:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 46: Integrated generic resources: Visual presentation.*

ISO 10303-49: 1994, *Industrial automation systems and integration — Product data representation and exchange — Part 49: Integrated generic resource: Process structure and properties.*

ISO 10303-101: 1994, *Industrial automation systems and integration — Product data representation and exchange — Part 101: Integrated application resource: Draughting.*

ISO 13584-1: *Industrial automation systems and integration — Parts library — Part 1: Overview and fundamental Principles.*

ISO 13584-42: *Industrial automation systems and integration — Parts library — Part 42: Methodology for Structuring Part Families.*

ISO 7967-1: 1987, *Reciprocating internal combustion engines — Vocabulary of components and systems.*

ISO 2710: 1978, *Reciprocating internal combustion engines - Vocabulary.*

IEC 50 (191): 1990-12, *First Edition, International Electrotechnical Vocabulary, Chapter 191: Dependability and quality of service.*

ISO DIS 14224: 1997, *Petroleum and natural gas industries – Collection and exchange of reliability and maintenance data for equipment.*

ISO 8402: 1986, *Quality – Vocabulary.*

EN 13306: (Draft European Standard): 1998, *Maintenance terminology.*

BS 4778 Part 2: 1991, *Quality concepts and related definitions.*

### **3 Terms, definitions and abbreviations**

#### **3.1 Terms defined in ISO 10303-1**

For the purpose of this part of ISO 10303, the following terms defined in ISO 10303-1 apply:

- abstract test suite (ATS);
- application;
- application activity model (AAM);

- application context;
- application interpreted model (AIM);
- application object;
- application protocol (AP);
- application reference model (ARM);
- assembly;
- conformance class;
- conformance requirement;
- conformance testing;
- context;
- data;
- data exchange;
- implementation method;
- information;
- integrated resource;
- interpretation;
- model;
- PICS proforma;
- product;
- product data;
- protocol implementation conformance statement (PICS);
- structure;
- unit of functionality (UoF).

### **3.2 Terms defined in ISO 10303-31**

For the purpose of this part of ISO 10303, the following terms defined in ISO 10303-31 apply:

- conformance testing;
- postprocessor;

- preprocessor.

### **3.3 Terms defined in ISO 10303-41**

For the purpose of this part of ISO 10303, the following terms defined in ISO 10303-41 apply:

- Address;
- Calendar\_date;
- Coordinated\_universal\_time\_offset;
- Date;
- Date\_and\_time;
- Date\_role;
- Date\_time\_role;
- Local\_time;
- Ordinal\_date;
- Organization;
- Organizational\_project;
- Person\_and\_organization;
- Time\_role;
- Week\_of\_year\_and\_day\_date.

### **3.4 Terms defined in ISO 10303-42**

For the purpose of this part of ISO 10303, the following terms defined in ISO 10303-42 apply:

- Cartesian\_point;
- Direction;
- Geometric\_representation\_item;
- Solid\_model.

### **3.5 Terms defined in ISO 10303-43**

For the purpose of this part of ISO 10303, the following terms defined in ISO 10303-43 apply:

- representation.

### 3.6 Terms defined in ISO 13584-42

For the purpose of this part of ISO 10303, the following terms defined in ISO 13584-42 apply:

- basic semantic unit;
- class valued property;
- data element type;
- dictionary data;
- dictionary element;
- non quantitative element type;
- property;
- quantitative element type;
- specific valued property;
- visible property.

### 3.7 Other definitions

For the purposes of this Part of ISO 10303, the following definitions apply:

**3.7.1 activity:** anything that is carried out by human or by knowledge-based systems on a mechanical product or in relation to a mechanical product.

**3.7.2 aft:** the location at or near the stern of the ship.

**3.7.3 anomaly:** a product problem or enhancement that may result in a change requirement. The product problems are deviations from expected product specification. The product enhancement is a need for improved product specification.

**3.7.4 assembly:** a composition (see 3.7.10) plus the specification of how the things in the composition are related to each other.

**3.7.5 class:** a concept to group items (see 3.7.29), with similar characteristics, with the purpose of describing the common properties of the class members. Each item belongs to at least one class.

NOTE a class usually has a criterion for inclusion or exclusion of items.

**3.7.6 classification:** the process of ensuring that a ship is designed, built and maintained to a prescribed standard.

**3.7.7 classification society:** an organisation that enhances the safety of life and property at sea by providing rules, regulations and personnel for assessing and classifying ships during their life cycle.

**3.7.8 collection:** a set of things that do not have any relationship to each other apart from being members of the same set.

**3.7.9 component:** a mechanical product that is part of another mechanical product and has not already been classified as a system (see 3.7.51) or an equipment (3.7.20). A component cannot have a system or an equipment as part of it.

**3.7.10 composition:** an association that indicates that one mechanical product is composed of many other mechanical products.

**3.7.11 configuration:** a data specification that deals with identification, approvals and versioning aspects of a mechanical product or its definitions (see 3.7.17).

**3.7.12 connecting component:** any intermediary mechanical product including weld, gaskets, bolts, nuts, and so on that are needed in order to realise a connection (see 3.7.13).

**3.7.13 connection:** an association between two mechanical products that results from a physical joining.

**3.7.14 connector:** a mechanical product that establishes an interface between two mechanical products or between a mechanical product and other category of items.

NOTE a connector is always part of a mechanical product that is intended to connect to another mechanical product.

**3.7.15 connector component:** a type of component (see 3.7.9) that plays the role of a connector (see 3.7.14).

**3.7.16 decomposition hierarchy:** a systematic breakdown of a mechanical product into its subsystems and components. The decomposition hierarchy for selected mechanical products are documented in Annex M of this part of ISO 10303.

**3.7.17 definitions:** an aggregation of the information and properties that characterise or describe one or many aspects of a mechanical product.

**3.7.18 definitions configuration:** a data specification that defines the configuration (see 3.7.11) for a set of definitions (see 3.7.17).

**3.7.19 document:** any type of information content in the form of manuals, computer files, catalogues, reports, books and so on in standard or non-standard formats.

**3.7.20 equipment:** a mechanical product that carries out a generally self contained function and to a large extent may be treated as a single mechanical product for the purpose of design, acquisition, or operation. An equipment has both physical and functional properties.

EXAMPLE a turbocharger is an equipment. A pump is also an equipment.

**3.7.21 event and approval data:** a set of data that relates to an event (see 3.7.22) and its approval/authorisation.

**3.7.22 event:** a state which identifies that something has happened at a certain time. A person normally causes the event.

**3.7.23 fore:** that part of the ship which is at the front of the ship.

**3.7.24 functional:** a reference to the actions, activities, or capabilities that a mechanical product provides or may provide to fulfil a purpose.

**3.7.25 functional characteristics:** nomenclature, codes, and named values that describe or specify the performance or behaviour of a mechanical product.



EXAMPLE typical functional characteristics of a diesel engine are its speed-power relationships. Typical pump characteristics are its head-flowrate relationships.

**3.7.26 functional specifications:** nomenclature, codes, and named values that describe or specify the performance or behaviour to be met by a mechanical product.

**3.7.27 general characteristics:** the most general and most widely used information relating to a mechanical product.

**3.7.28 inertia:** the tendency of a body rotating about a fixed axis to resist a change in this rotating motion. Normally referred to as moment of inertia.

**3.7.29 item:** any part, component, subsystem, functional unit, equipment, or system of a ship that can be individually considered. The item refers to all the mechanical, electrical, structural, and other physical elements as well as non-physical aspects such as tasks, faults, failures and so on.

**3.7.30 life cycle status:** the product data that specify where in its lifecycle the product is.

**3.7.31 machinery:** a reciprocating or rotating equipment that performs some sort of energy conversion as its underlying function.

**3.7.32 manoeuvring system:** a system (see 3.7.51) used to perform planned movement or change from the straight, steady course and speed of a ship or to maintain the vessel in a given stationary location and heading.

**3.7.33 mechanical equipment:** a non-machinery equipment that is primarily used in mechanical systems. Gear boxes and couplings are examples of mechanical equipment.

**3.7.34 mechanical machinery:** a machinery (see 3.7.31) that is primarily used in mechanical systems.

EXAMPLE all kinds of reciprocating and rotary engines are examples of mechanical machinery.

**3.7.35 mechanical product:** any item (see 3.7.29) of the ship mechanical systems that is realisable as a physical thing. A mechanical product has both physical and functional properties.

**3.7.36 mechanical system:** a system (see 3.7.36) that is within the scope (see 1) of this part of ISO 10303.

**3.7.37 mechanical transmission system:** a system (see 3.7.51) by which motive power from the prime mover is made available and matched to load. Shafting system connecting main engine to propeller, or shafting system connecting auxiliary engine to electric generators are examples of mechanical transmission systems.

**3.7.38 members of composition:** those mechanical products that appear at the first decomposition level of the decomposition hierarchy (see 3.7.16). The members of composition within this part of ISO 10303 are those specified in Annex M.

**3.7.39 part:** any mechanical product at the atomic (lowest composition) level.

**3.7.40 physical:** a reference term which refers to shape and material characteristics such as weight, size, and location of the mechanical product.

**3.7.41 port:** a type of connector (see 3.7.14) that enables a flow of energy, load, process material or signal to or from another mechanical product.

**3.7.42 product connectivity:** a data specification that defines all aspects of product connections (see 3.7.13) in relation to external systems and equipments.

**3.7.43 product structure:** a data specification that defines the following in relation to a mechanical product: i) the system for which the mechanical product is a part, ii) the items that are part of the mechanical product, and iii) the position and location of a mechanical product.

**3.7.44 propulsion system:** a system (see 3.7.51), comprising of prime movers, shafting systems and propulsors, that produces the required thrust for the ship movement using and converting fuel energy.

**3.7.45 propulsor:** a powered equipment that sets up a thrust on the water to enable a ship to move in a controlled direction.

### **3.7.1 EXAMPLE propeller is an example of a propulsor.**

**3.7.46 schematic presentation:** a type of drawing that conveys information about relationships among things by the relative physical position of symbols.

**3.7.47 screw propeller:** a revolving boss with blades that are usually set at an angle and twisted like the threads of a screw. When the propeller is rotated in the water, a column of water passes through it, gaining momentum. The reactive force which arises is taken up by the thrust bearing in the transmission system, enabling the ship to move.

**3.7.48 ship mechanical system:** a mechanical system (see 3.7.36) that provides or performs, or is intended to provide or perform, a service or function contributing to or enabling the operation of a ship.

**3.7.49 ship operation:** all activities required by ship operator and onboard crew to enable the intended services of the ship.

NOTE in this application protocol the main emphasis is on the technical aspect of the ship operation. The ship operation phase within the ship lifecycle starts when the ship is commissioned and ends when the ship is scrapped.

**3.7.50 solid model:** a geometric representation of a mechanical product and deals mainly with external geometries including shape, volume, area and so on.

**3.7.51 system:** an assembly of one or more items (see 3.7.29), with functional and physical relationships between them, that performs or can perform a clearly identified function as a whole. A system may have both physical and functional properties.

**3.7.52 task:** anything that is carried out by a human on a mechanical product or in relation to a mechanical product. Each task has a clear beginning and ending.

## **3.8 Abbreviations**

For the purposes of this Part of ISO 10303, the following abbreviations apply.

AAM application activity model

AIM application interpreted model

ARM application reference model

AP application protocol

BSU basic semantic unit

CAD	computer aided design
ICS	international classification of standards
IDEF0	integrated definition method
MP	mechanical product
PICS	protocol implementation conformance statement
SI	système international
UoF	units of functionality

## 4 Information requirements

This clause specifies the information required for the exchange of ship's mechanical systems data.

The information requirements are specified as a set of units of functionality, application objects, and application assertions. These assertions pertain to individual application objects and to relationships between application objects. The information requirements are defined using the terminology of the subject area of this application protocol.

NOTE 1 a graphical representation of the information requirements is given in annex G.

NOTE 2 the information requirements correspond to those of the activities identified as being in the scope of this application protocol in annex F.

NOTE 3 the mapping table is specified in 5.1 which shows how the information requirements are met using the integrated resources of this International Standard. The use of the integrated resources introduces additional requirements which are common to all application protocols.

### 4.1 Units of functionality

This subclause specifies the units of functionality for the Ship's Mechanical Systems application protocol. This Part of ISO 10303 specifies the following units of functionality:

- date\_and\_time;
- dictionary\_items\_and\_definitions;
- external\_references;
- items\_and\_definitions;
- measure\_with\_units;
- mechanical\_product\_representations;
- mechanical\_product\_structures;
- part41\_resources;
- part42\_resources;
- part\_library\_references;
- schedule\_and\_events;
- ship\_voyages;
- ships.

The units of functionality and a description of the functions that each UoF supports are given below. The application objects included in the UoFs are defined in clause 4.2.

#### 4.1.1 date\_and\_time

The date\_and\_time UoF specifies the date and time related application objects which are in ISO10303-41 and are used by this part of ISO 10303.

The following application objects are used by the date\_and\_time UoF:

- Calendar\_date;
- Coordinated\_universal\_time\_offset;
- Date;
- Date\_and\_time;
- Date\_role;
- Date\_time\_role;

- Local\_time;
- Ordinal\_date;
- Time\_role;
- Week\_of\_year\_and\_day\_date.

### 4.1.2 dictionary\_items\_and\_definitions

The dictionary\_items\_and\_definitions UoF specifies the framework for representing all the classes and their properties that are specified in ISO 13584 compliant dictionaries within this part of ISO 10303. The concept for grouping of the properties in generic way is also supported within this UoF.

The following application objects are used by the dictionary\_items\_and\_definitions UoF:

- Anomaly\_product\_relationship;
- Anomaly\_relationship;
- Anomaly\_task\_relationship;
- Dictionary\_definition;
- Dictionary\_item;
- Grouped\_property;
- Material;
- Mechanical\_product;
- Product\_anomaly;
- Product\_connection;
- Product\_relationship;
- Product\_space\_site\_relationship;
- Product\_task\_relationship;
- Space\_site;
- Task;
- Task\_relationship.

### 4.1.3 external\_references

The external\_references UoF specifies an external reference mechanism to assign additional documentation in electronic or non-electronic form to the product, task/activity or definitions. The external\_references UoF also facilitates access to information, standard or non-standard, on ship mechanical systems that are outside the scope of this part of ISO 10303.

NOTE 1 all types of user manuals, computer files, catalogues, reports, books and so on are considered as external documents and are in the scope of this UoF.

NOTE 2 the referencing of external databases and data libraries, standard or non-standard, are in the scope of this UoF.

NOTE 3 the referencing of the ISO 13584 compliant libraries is outside the scope of this UoF and is covered in part\_library\_references UoF (see 4.1.10).

The following application objects are used by the external\_references UoF:

- Document;
- Document\_reference;
- External\_instance\_reference;
- External\_mechanical\_product\_definition;
- External\_reference;
- External\_reference\_inside\_source;

- Global\_unique\_identifier.

#### 4.1.4 items\_and\_definitions

The items\_and\_definitions UoF specifies the high level concept and framework for representation of items (see 3.7.29), definitions (see 3.7.17) and their relationships in a compatible way to other ship Application Protocols.

The following application objects are used by the items\_and\_definitions UoF:

- Definable\_object;
- Definition;
- Definition\_relationship;
- Item;
- Item\_relationship;
- Library\_definition;
- Revision.

#### 4.1.5 measure\_with\_units

The measure\_with\_units UoF specifies the concept for representing measures for physical quantities together with their units.

The following application objects are used by the measure\_with\_units UoF:

- Density;
- Dilatation;
- Electrical\_current;
- Energy;
- Energy\_per\_mass;
- Force;
- Frequency;
- Heat\_capacity;
- Inertia\_moment;
- Length;
- Linear\_damping\_coefficient;
- Linear\_stiffness;
- Mass;
- Mass\_flow;
- Measure\_with\_unit;
- Molecular\_weight;
- Plane\_angle;
- Power;
- Pressure;
- Ratio;
- Rotational\_damping\_coefficient;
- Rotational\_speed;
- Rotational\_stiffness;
- Specific\_fuel\_consumption;
- Speed;
- Stress;
- Surface\_tension;
- Temperature;
- Thermal\_conductivity;

- Time;
- Torque;
- Viscosity;
- Voltage;
- Volume\_flow.

#### 4.1.6 mechanical\_product\_representations

The mechanical\_product\_representations UoF specifies the concept for the representation of mechanical product's detailed geometric definitions in the form of shape representation (solid model) and drawing. The mechanical\_product\_representations UoF also facilitates the exchange of identification information on drawings, in addition to the exchange of drawing itself.

NOTE 1 definition of the internal geometry of mechanical products is outside the scope of this UoF.

NOTE 2 information on drawings for identification purposes and association of a drawing to a mechanical product is within the scope of this UoF.

The following application objects are used by the mechanical\_product\_representations UoF:

- Axis2\_placement;
- CAD\_system;
- External\_drawing;
- External\_shape\_representation;
- Mechanical\_product\_drawing;
- Mechanical\_product\_representation;
- Mechanical\_product\_shape\_representation;
- Part\_library\_defined\_shape\_representation.

#### 4.1.7 mechanical\_product\_structures

The mechanical\_product\_structures UoF defines the internal composition (see 3.7.10), external participation (being part of something else) and connectivity of mechanical products.

NOTE 1 this UoF is always used in conjunction with the mechanical\_products UoF for which composition, participation and connectivity need to be defined.

NOTE 2 the composition of mechanical products will be supported in terms of mechanical product hierarchical decomposition, as developed and documented within this part of ISO 10303 (see Annex M).

NOTE 3 the connectivity of mechanical product to its boundary mechanical products and ship structures are facilitated by inclusion of connectors (see 3.7.14) within the internal composition of mechanical products. However, the definition of a physical connection (see 3.7.13) is outside the scope of this UoF.

The following application objects are used by the mechanical\_product\_structures UoF:

- Product\_assemblage;
- Product\_composition;
- Product\_connectivity;
- Product\_participation;
- Product\_structure\_definition.

#### **4.1.8 part41\_resources**

The part41\_resources UoF specifies the application objects which are in ISO10303-41 and are used by this part of ISO 10303.

The following application objects are used by the part41\_resources UoF:

- Address;
- Organization;
- Organizational\_project;
- Person;
- Person\_and\_organization;

#### **4.1.9 part42\_resources**

The part42\_resources UoF specifies all the application objects which are in ISO10303-42 and are used by this part of ISO 10303.

The following application objects are used by the part42\_resources UoF:

- Cartesian\_point;
- Direction;
- Geometric\_representation\_item;
- Solid\_model;

#### **4.1.10 part\_library\_references**

The part\_library\_references UoF specifies the data structure for externally referencing an ISO 15358 compliant supplier library.

The following application objects are used by the part\_library\_references UoF:

- Basic\_semantic\_unit;
- Binary\_value;
- Boolean\_value;
- Class\_BSU;
- Class\_instance\_value;
- Entity\_instance\_value;
- Integer\_value;
- Library\_element\_reference;
- Library\_property\_and\_property\_value;
- Logical\_value;
- Number\_value;
- Property\_BSU;
- Real\_value;
- String\_value;
- Supplier\_BSU.

#### **4.1.11 schedule\_and\_events**



The `schedule_and_events` UoF specifies the concept for describing the events and their authorisation and approval. All the events which take place during the various stages of ship life cycle are in the scope of the `schedule_and_events` UoF.

The following application objects are used by the `schedule_and_events` UoF:

- `Approval_event`;
- `General_event`;
- `Time_schedule`.

#### **4.1.12 ship\_voyages**

The `ship_voyages` UoF specifies the data structures for defining the ship voyage including ports visited, shipyard stays, seas and time schedule and delays.

The following application objects are used by the `ship_voyages` UoF:

- `Restricted_water`
- `Sea`
- `Sea_port`
- `Ship_at_port`
- `Ship_at_restricted_water`
- `Ship_at_sea`
- `Ship_at_shipyard`
- `Ship_voyage`
- `Shipyard`.

#### **4.1.13 ships**

The `ships` UoF specifies the information required to describe the ship. All ship product data are defined independent of the ship and have a reference to it. The `ships` UoF describes the essential information to permit that reference. The applications objects in this UoF are common to all ship related APs..

The following application objects are used by the `ships` UoF:

- `Class_parameters`;
- `Principal_characteristics`;
- `Ship`;
- `Ship_designation`;
- `Ship_general_characteristic`;
- `Ship_operation_characteristic`;
- `Ship_overall_dimensions`;
- `Shipyard_designation`.

## 4.2 Application objects

This subclause specifies the application objects for the ship mechanical systems application protocol. Each application object is an atomic element that embodies a unique application concept and contains attributes specifying the data elements of the object. The application objects and their definitions are given below.

### 4.2.1 Address

An Address specifies postal data associated with a person or organisation. It is used as defined in ISO 10303-41.

### 4.2.2 Anomaly\_product\_relationship

An Anomaly\_product\_relationship is a type of Item\_relationship (see 4.2.51) and specifies the concept for relating a Product\_anomaly (see 4.2.81) to a Mechanical\_product (see 4.2.65).

### 4.2.3 Anomaly\_relationship

An Anomaly\_relationship is a type of Item\_relationship (see 4.2.51) and specifies the concept for relating two product anomalies to each other.

### 4.2.4 Anomaly\_task\_relationship

An Anomaly\_task\_relationship is a type of Item\_relationship (see 4.2.51) and specifies the concept for relating a Product\_anomaly (see 4.2.81) to a Task (see 4.2.121).

### 4.2.5 Approval\_event

An Approval\_event is a type of General\_event (see 4.2.43) and specifies an approval or authorisation event.

The data associated with an Approval\_event are the following:

— approval\_status.

#### 4.2.5.1 approval\_status

The approval\_status specifies the result of the approval activity.

The value of approval\_status shall be one of the following:

— approved;  
— noted;  
— rejected;  
— unapproved.

**4.2.5.1.1 approved: the descriptor which specifies that the approval event has led to acceptance of the subject matter.**

**4.2.5.1.2 noted: the descriptor which specifies that the need for an approval decision for a subject matter has been identified.**

**4.2.5.1.3 rejected:** The descriptor which specifies that the subject matter has been rejected.

**4.2.5.1.4 unapproved:** the descriptor which specifies that the subject matter is in the process of being reviewed by the organisation responsible for approval.

## **4.2.6 Axis2\_placement**

The Axis2\_placement specifies the shape representation according to ISO 13584.

## **4.2.7 Basic\_semantic\_unit**

A Basic\_semantic\_unit, as defined in ISO 13584-42, specifies the information needed for referencing the content of an ISO 13584 compliant data dictionary.

The data associated with a Basic\_semantic\_unit are the following:

- code;
- version.

### **4.2.7.1 code**

The code uses identifier (specified in ISO 10303-41) that assigns a unique code to the Basic\_semantic\_unit.

### **4.2.7.2 version**

The version uses identifier (specified in ISO 10303-41) that assigns a version number to the Basic\_semantic\_unit.

## **4.2.8 Binary\_value**

The Binary\_value specifies that the property value is of type binary.

The data associated with a Binary\_value are the following:

- the\_value.

The the\_value specifies the actual value of the property in the form of a binary number (comprising of zeros or ones).

## **4.2.9 Boolean\_value**

The Boolean\_value specifies that the property value is of type boolean.

The data associated with a Boolean\_value are the following:

- the\_value.

The the\_value specifies the actual value of the property in the form of a boolean number (zero or one).

## **4.2.10 CAD\_system**

The CAD\_system specifies the name and version number of the CAD system used to generate the drawing.

The data associated with a CAD\_system are the following:

- name;
- version\_number.

#### **4.2.10.1 name**

The name specifies, as text, the name of the CAD system used .

#### **4.2.10.2 version\_number**

The version\_number uses identifier (specified in ISO 10303-41) that assigns a version number to the CAD\_system.

#### **4.2.11 Calendar\_date**

A Calendar\_date specifies the date as defined in ISO 10303-41.

#### **4.2.12 Cartesian\_point**

A Cartesian\_point specifies a point defined by its coordinates in a rectangular Cartesian coordinate system, or in a parameter space. The entity is defined in a one, two or three-dimensional space as determined by the number of coordinates in the list. It is used as defined in ISO 10303-42.

#### **4.2.13 Class\_BSU**

A Class\_BSU is a type of Basic\_semantic\_unit (see 4.2.7) and specifies the identification information for referencing a class as defined in an ISO 13584 compliant data dictionary.

The data associated with a Class\_BSU are the following:

- delivered\_by.

The delivered\_by specifies the supplier of the ISO 13584 compliant data library.

#### **4.2.14 Class\_instance\_value**

A Class\_instance\_value specifies that the property value is of type class instance. The class instance is defined in ISO 13584 compliant dictionary

#### **4.2.15 Class\_parameters**

A Class\_parameters is a type of Ship\_general\_characteristic (see 4.2.107) and specifies the length and speed of the ship in accordance with the classification society rules and statutory regulations.

The data associated with Class\_parameters are the following:

- block\_coefficient\_class;
- defined\_for;
- design\_speed\_ahead;
- design\_speed\_astern;
- froude\_number;
- length\_class;

- length\_solas;
- scantlings\_draught.

#### **4.2.15.1 block\_coefficient\_class**

The block\_coefficient\_class specifies the ratio of the moulded displacement volume to the volume of a block that has its length equal to the length\_class, its breadth equal to the moulded\_breadth and its depth equal to the scantlings\_draught. The block\_coefficient\_class need not be specified for a particular Class\_parameter.

#### **4.2.15.2 defined\_for**

The defined\_for specifies a set of one to many ships for which class parameters are defined.

#### **4.2.15.3 design\_speed\_ahead**

The design\_speed\_ahead specifies the forward speed at which the ship is designed to operate.

#### **4.2.15.4 design\_speed\_astern**

The design\_speed\_astern specifies the reverse speed at which the ship is designed to operate.

#### **4.2.15.5 froude\_number**

The froude\_number specifies the ship froude number that is of significance to the resistance and propulsion calculations of a ship. The Froude number is a nondimensional parameter that is defined by dividing the ship speed in meter per second by the square root of the product of the length of the ship in meter and the gravitational acceleration in meter per square second. In the DERIVE clause the design\_speed\_ahead for the ship speed and the length\_class for the length of the ship are used.

#### **4.2.15.6 length\_class**

The length\_class specifies the ship length as is defined in classification society rules.

#### **4.2.15.7 length\_solas**

The length\_solas specifies the length measurement for the ship in accordance with the International Convention on the Safety of Life at Sea.

#### **4.2.15.8 scantlings\_draught**

The scantlings\_draught specifies the summer load draught used by the classification society in its calculations for structural integrity and strength.

### **4.2.16 Coordinated\_universal\_time\_offset**

A Coordinated\_universal\_time\_offset specifies time reference in terms of universal time offset. It is used as defined in ISO 10303-41.

### **4.2.17 Date**

A Date specifies the complete calendar date. It is used as defined in ISO 10303-41.

#### **4.2.18 Date\_and\_time**

A Date\_and\_time specifies the combined calendar date and the day time. It is used as defined in ISO 10303-41.

#### **4.2.19 Date\_role**

A Date\_role specifies additional description for the use of date. It is used as defined in ISO 10303-41.

#### **4.2.20 Date\_time\_role**

A Date\_time\_role specifies additional description for the combined use of date and time. It is used as defined in ISO 10303-41.

#### **4.2.21 Definable\_object**

A Definable\_object is the supertype for all the objects which need to be defined.

The data associated with a Definable\_object are the following:

— definitions.

The definitions attribute references a set of zero to many Definitions (see 4.2.22) which relate to a Definable\_object.

#### **4.2.22 Definition**

A Definition is the top level concept for specifying product's definitions (see 3.7.17). Within this part of ISO 10303, each definition is either a Library\_definition (see 4.2.54), a Mechanical\_product\_representation (see 4.2.67), a Product\_structure\_definition (see 4.2.89) or a Ship\_general\_characteristic (see 4.2.107).

The data associated with a Definition are the following:

— defined\_for.

The defined\_for specifies the objects which are characterised by the Definition. There may be more than one defined\_for for a Definition.

#### **4.2.23 Definition\_relationship**

A Definition\_relationship defines a relationship between definitional entities that together are the subject of a revision control and also specifies extra information about their relationship.

The data associated with a Definition\_relationship are the following:

— definition\_one;  
— definition\_two;  
— description.

##### **4.2.23.1 definition\_one**

The definition\_one specifies the first Definition (see 4.2.22) that forms a relationship with another definition.

#### **4.2.23.2 definition\_two**

The definition\_two specifies the second Definition (see 4.2.22) that forms a relationship with another definition.

#### **4.2.23.3 description**

The description specifies, as text, the important aspects of the relationship between definitional entities. The description need not be specified for a particular Definition\_relationship.

### **4.2.24 Density**

A Density is a type of Measure\_with\_unit (see 4.2.64) where the physical quantity is the density of a material.

The data associated with a Density are the following:

- density\_unit.

The density\_unit attribute specifies all the units which can be used to specify density.

### **4.2.25 Dictionary\_definition**

A Dictionary\_definition is a type of Library\_definition (see 4.2.22) and specifies the concept for grouping of the properties that are defined in an ISO 13584 compliant data dictionary for use within this part of ISO 10303.

The data associated with a Dictionary\_definition are the following:

- defined\_for;
- definition\_entity\_name;
- grouped\_properties;
- property\_and\_property\_value.

#### **4.2.25.1 defined\_for**

The defined\_for specifies a set of one to many Items from an ISO 13584 compliant data dictionary.

#### **4.2.25.2 definition\_entity\_name**

The definition\_entity\_name specifies the name of entity according to implementation agreement.

#### **4.2.25.3 grouped\_properties**

The grouped\_properties specify a set of Grouped\_property (see 4.2.46), representing whole sets of, if any, properties according to ISO 13584. There may be more than one grouped\_properties for a Dictionary\_definition.

#### **4.2.25.4 property\_and\_property\_value**

The property\_and\_property\_value specifies a set of Library\_property\_and\_property\_value (see 4.2.56), defining the type of property and its value according to ISO 13584. There may be more than one property\_and\_property\_value for a Dictionary\_definition.

## 4.2.26 Dictionary\_item

A Dictionary\_item is a type of Item (see 4.2.50) and specifies the concept for identifying the items (see 3.7.29) that are defined in an ISO 13584 compliant data dictionary for use within this part of ISO 10303. Within this part of ISO 10303 each Dictionary\_item is either a Material (see 4.2.30), a Mechanical\_product (see 4.2.35), a Product\_anomaly (see 4.2.40), a Space\_site (see 4.2.114) or a Task (see 4.2.121).

The data associated with a Dictionary\_item are the following:

- class\_bsu;
- definitions.

### 4.2.26.1 class\_bsu

The class\_bsu specifies the identification information for referencing a class as defined in an ISO 13584 compliant data dictionary.

### 4.2.26.2 definitions

The definitions attribute references a set of zero to many Dictionary\_definition (see 4.2.25) which relate to a Dictionary\_item.

## 4.2.27 Dilatation

A Dilatation is a type of Measure\_with\_unit (see 4.2.64) where the physical quantity is an increase in volume per unit volume of a continuous substance due to deformation.

The data associated with a Dilatation are the following:

- dilatation\_unit.

The dilatation\_unit specifies all the units that can be used to specify dilatation.

## 4.2.28 Direction

A Direction specifies a general direction vector in two or three dimensional space. It is used as defined in ISO 10303-42.

## 4.2.29 Document

A Document specifies global identification information for a document. Within this part of ISO 10303 each Document is either a Document\_reference (see 4.2.30), an External\_drawing (see 4.2.35) or an External\_shape\_representation (see 4.2.40).

The data associated with a Document are the following:

- approval\_details;
- author;
- document\_description;
- document\_identifier;
- document\_type;
- internal\_locations;



- title;
- version\_identifier.

#### **4.2.29.1 approval\_details**

The approval\_details specifies the approval status of a document, such as approved or rejected. There may be more than one approval\_details for each Document.

#### **4.2.29.2 author**

The author attribute specifies full details of the authors of the document. There may be more than one author for a Document.

#### **4.2.29.3 document\_description**

The document\_description specifies, as text, significant information about the document.

#### **4.2.29.4 document\_identifier**

The document\_identifier specifies, as text, a set of characters used to uniquely identify the document locally.

#### **4.2.29.5 document\_type**

The document\_type specifies the type of each document.

The value for document\_type shall be one of the following:

- book;
- drawing;
- report;
- user\_defined.

**4.2.29.5.1 book:** the descriptor that identifies the document as a book.

**4.2.29.5.2 drawing:** the descriptor that identifies the document as a technical drawing.

**4.2.29.5.3 report:** the descriptor that identifies the document as a report.

**4.2.29.5.4 user\_defined:** the descriptor, set by the user, that specifies the type of document if different from all other options.

#### **4.2.29.6 internal\_locations**

The internal\_location specifies, as text, additional information about the location of the document within the company or organisation. An internal\_location need not be specified for a particular Document.

#### **4.2.29.7 title**

The title specifies, as text, the common title used to identify the content of the document.

#### **4.2.29.8 version\_identifier**

The version\_identifier specifies, as text, the version number of the document.

#### **4.2.30 Document\_reference**

A Document\_reference is a type of External\_reference (see 4.2.38) and a type of Document (see 4.2.29) and specifies the qualification of a Document in terms of its source and location.

#### **4.2.31 Electrical\_current**

An Electrical\_current is a type of Measure\_with\_unit (see 4.2.64) where the physical quantity is the electrical current.

The data associated with an Electrical\_current are the following:

— electrical\_current\_unit.

The electrical\_current\_unit specifies all the engineering units which can be used for electrical current.

#### **4.2.32 Energy**

An Energy is a type of Measure\_with\_unit (see 4.2.64) where the physical quantity is the energy.

The data associated with an Energy are the following:

— energy\_unit.

The energy\_unit specifies all the engineering units which can be used for energy.

#### **4.2.33 Energy\_per\_mass**

An Energy\_per\_mass is a type of Measure\_with\_unit (see 4.2.64) when the physical quantity is the specific energy (energy per mass) of a material.

The data associated with an Energy\_per\_mass are the following:

— energy\_per\_mass\_unit.

The energy\_per\_mass\_unit attribute specifies all the units which can be used to specify density.

#### **4.2.34 Entity\_instance\_value**

An Entity\_instance\_value specifies that the property value is of type entity instance that has been defined in an ISO 13584 compliant data dictionary.

The data associated with a Entity\_instance\_value are the following:

— the\_value.

The the\_value specifies the Organization (see 4.2.72) or the Date (see 4.2.17) associated with the entity instance.

#### **4.2.35 External\_drawing**

An `External_drawing` is a type of `Document` (see 4.2.29) and specifies information for identification of CAD drawings and their approval details.

The data associated with an `External-drawing` are the following:

- `CAD_system_details`;
- `drawing_type`.

#### 4.2.35.1 `CAD_system_details`

The `CAD_system_details` specifies the name and version number of the CAD system used to generate the drawing.

#### 4.2.35.2 `drawing_type`

The `drawing_type` attribute specifies the type of the drawing.

The value of `drawing_type` shall be one of the following:

- `detailed_arrangement`;
- `exploded_view`;
- `general_arrangement`;
- `schematic`;
- `sectional_view`;
- `user_defined_drawing_type`.

**4.2.35.2.1 `detailed_arrangement`:** the descriptor that specifies that the drawing is a detailed arrangement.

**4.2.35.2.2 `exploded_view`:** the descriptor that specifies that the drawing is an exploded view of a mechanical product.

**4.2.35.2.3 `general_arrangement`:** the descriptor that specifies that the drawing is of type general arrangement.

**4.2.35.2.4 `schematic`:** the descriptor that specifies that the drawing is of type schematic.

**4.2.35.2.5 `sectional_view`:** the descriptor which specifies that the drawing is of type sectional view.

**4.2.35.2.6 `user_defined_drawing_type`:** the descriptor, set by the user, which specifies the type of drawing if different from the other options.

### 4.2.36 `External_instance_reference`

An `External_instance_reference` is a type of `External_reference` (see 4.2.38) that specifies the concept for referencing an external instance of application objects in an exchange file.

The data associated with an `External_instance_reference` are the following:

- `entity_name`;
- `global_unique_identifier`;
- `schema_name`.

#### 4.2.36.1 `entity_name`

The `entity_name` specifies, as label, the name of the externally referenced entity.

#### **4.2.36.2    `global_unique_identifier`**

The `global_unique_identifier` specifies a unique identifier for externally referenced entity.

#### **4.2.36.3    `schema_name`**

The `schema_name` specifies, as label, the name of the schema within which the entity is located.

### **4.2.37    `External_mechanical_product_definition`**

An `External_mechanical_product_definition` is a type of `External_instance_reference` (see 4.2.36) that specifies the concept for referencing an externally defined instance of all the entities defined in this part of ISO 10303.

### **4.2.38    `External_reference`**

An `External_reference` specifies the high level concept for referencing an information source, external to this part of ISO 10303. Within this part of ISO 10303 each `External_reference` is either a `Document_reference` (see 4.2.30), an `External_instance_reference` (see 4.2.36) or an `External_reference_inside_source` (see 4.2.39).

The data associated with an `External_reference` are the following:

- `description`;
- `location`;
- `source_type`.

#### **4.2.38.1    `description`**

The `description` specifies a description of the external source in text format.

#### **4.2.38.2    `location`**

The `location` specifies, as text, information required to identify the location of an external source.

#### **4.2.38.3    `source_type`**

The `source_type` specifies, as text, the type of the external source.

### **4.2.39    `External_reference_inside_source`**

An `External_reference_inside_source` is a type of `External_reference` (see 4.2.38) with a pointer to a location inside the source of information. If the source is for example a book, the pointer could be a section label or a page number.

The data associated with an `External_reference_inside_source` are the following:

- `line_number`;
- `page`;
- `paragraph`;
- `section`.

#### 4.2.39.1 line\_number

The line\_number specifies a line number within the source of information. The line\_number need not be specified for a particular External\_reference\_inside\_source.

#### 4.2.39.2 page

The page specifies the page number within the source of information. The page need not be specified for a particular External\_reference\_inside\_source.

#### 4.2.39.3 paragraph

The paragraph specifies the paragraph identifier within the source of information. The paragraph need not be specified for a particular External\_reference\_inside\_source.

#### 4.2.39.4 section

The section specifies a section label within the source of information . The section need not be specified for a particular External\_reference\_inside\_source.

### 4.2.40 External\_shape\_representation

An External\_shape\_representation is a type of Document (see 4.2.29) and provides details of a document that represents a CAD generated shape representation of a mechanical product.

The data associated with an External\_shape\_representation are the following:

- CAD\_system\_details;
- shape\_representation\_type.

#### 4.2.40.1 CAD\_system\_details

The CAD\_system\_details specifies the name and version number of the CAD system used to generate the shape of the product.

#### 4.2.40.2 shape\_representation\_type

The shape\_representation\_type specifies the type of the product shape representation.

The value of shape\_representation\_type shall be one of the following:

- user\_defined

**user\_defined:** the descriptor, set by the user, that specifies the type of the shape representation.

### 4.2.41 Force

A Force is a type of Measure\_with\_unit (see 4.2.64) where the physical quantity is the force.

The data associated with a Force are the following:

- Force\_units.

The Force\_unit specifies all the engineering units which can be used for Force.

#### **4.2.42 Frequency**

A Frequency is a type of Measure\_of\_unit (see 4.2.64) where the physical quantity is the frequency.

The data associated with a Frequency are the following:

— frequency\_units.

The frequency\_unit specifies all the engineering units which can be used for frequency.

#### **4.2.43 General\_event**

A General\_event identifies that something has happened at a certain time, activated by a certain person for a certain reason.

The data associated with a General\_event are the following:

- caused\_by;
- caused\_when;
- description.

##### **4.2.43.1 caused\_by**

The caused\_by specifies the person causing an event.

##### **4.2.43.2 caused\_when**

The caused\_when specifies the date and time the event occurred.

##### **4.2.43.3 description**

The description specifies a textual description of significant features and reasons for the event. The description need not be specified for a particular General\_event.

#### **4.2.44 Geometric\_representation\_item**

A Geometric\_representation\_item is an element of geometric product data that either participates in one or more representations. It is used as defined in ISO 10303-42.

#### **4.2.45 Global\_unique\_identifier**

A Global\_unique\_identifier specifies an identifier used for uniquely identifying an externally referenced entity.

The data associated with a Global\_unique\_identifier are the following:

- company\_identification;
- company\_name.

##### **4.2.45.1 company\_identification**

The `company_identification` is a company-specific unique identification label.

#### **4.2.45.2      `company_name`**

The `company_name` is the name of the company for which `company_identification` is specified.

#### **4.2.46      `Grouped_property`**

A `Grouped_property` specifies a composition of properties for a class that are normally used together as a group in practical data exchange scenarios. The exact composition of a `Grouped_property` will be defined during implementation.

The data associated with a `Grouped_property` are the following:

- `group_properties`;
- `grouped_property_name`;
- `property_and_property_value`.

##### **4.2.46.1      `group_properties`**

The `group_properties` specify a set of `Grouped_property`, representing complex data types comprising of a collection of properties for a class. There may be more than one `group_properties` for a `Grouped_property`.

##### **4.2.46.2      `grouped_property_name`**

The `grouped_property_name` specifies, as text, the name used to identify grouped property.

##### **4.2.46.3      `property_and_property_value`**

The `property_and_property_value` specifies a set of `Library_property_and_property_value` (see 4.2.56), representing a single property of a class and its value. There may be more than one `property_and_property_value` for a `Grouped_property`.

#### **4.2.47      `Heat_capacity`**

A `Heat_capacity` is a type of `Measure_with_unit` (see 4.2.64) where the physical quantity is the heat capacity of a material.

The data associated with a `Heat_capacity` are the following:

- `heat_capacity_unit`.

The `heat_capacity_unit` specifies all the units which can be used for heat capacity.

#### **4.2.48      `Inertia_moment`**

An `Inertia_moment` is a type of `Measure_with_unit` (see 4.2.64) where the physical quantity is the moment of inertia of something.

The data associated with an `Inertia_moment` are the following:

- `inertia_moment_unit`.

The `inertia_moment_unit` specifies all the units which can be used to specify moment of inertia.

#### **4.2.49 Integer\_value**

The `Integer_value` specifies that the property value is of type integer.

The data associated with a `Integer_value` are the following:

- `the_value`.

The `the_value` specifies the actual value of the property in the form of an integer number (whole number).

#### **4.2.50 Item**

An `Item` is a type of `Definable_object` (see 4.2.21) that specifies the high level concept for any of the items (see 3.7.29) that need to be defined or described.

The data associated with an `Item` are the following:

- `description`;
- `documentation`;
- `identifier`;
- `name`.

##### **4.2.50.1 description**

The `description` specifies a textual description for the item.

##### **4.2.50.2 documentation**

The `documentation` specifies the documentation available, if any, for the item. There may be more than one `documentation` for an `Item`.

##### **4.2.50.3 identifier**

The `identifier` specifies a text string for unique identification of the item.

##### **4.2.50.4 name**

The `name` specifies, as text, the name that is commonly associated with the item.

#### **4.2.51 Item\_relationship**

An `Item_relationship` is a type of `Definable_object` (see 4.2.21) and defines the association between two items.

The data associated with an `Item_relationship` are the following:

- `description`;
- `item_one`;
- `item_two`.



### **4.2.51.1 description**

The description specifies the significant aspect of the relationship in the text format. The description need not be specified for a particular Item\_relationship.

### **4.2.51.2 item\_one**

The item\_one specifies the first Item (see 4.2.50) that forms a relationship with another Item.

### **4.2.51.3 item\_two**

The item\_two specifies the second Item (see 4.2.50) that forms a relationship with another Item.

## **4.2.52 Label**

A Label is used to assign a character label to something. It is used as defined in ISO 10303-41.

## **4.2.53 Length**

A Length is a type of Measure\_with\_unit (see 4.2.64) where the physical quantity is the length of something.

The data associated with a Length are the following:

- length\_unit.

The length\_unit attribute specifies all the units which can be used to specify length.

## **4.2.54 Library\_definition**

A Library\_definition is a type of Definition (see 4.2.22) and specifies the concept for grouping of the properties that are defined in an ISO 13584 compliant data dictionary for use within this part of ISO 10303.

## **4.2.55 Library\_element\_reference**

A Library\_element\_reference specifies the complete set of information for referencing an instance of a mechanical product in an ISO 13584 compliant data library.

The data associated with a Library\_element\_reference are the following:

- class\_identifier;
- property\_value\_pairs.

### **4.2.55.1 class\_identifier**

The class\_identifier specifies the identification information for type of mechanical product.

### **4.2.55.2 property\_value\_pairs**

The property\_value\_pairs specify a set of Library\_property\_and\_property\_value (see 4.2.56), representing the mechanical product properties and their values. These properties and their values are

used to select an instance of the mechanical product from an ISO 13584 compliant data library. There may be more than one `property_value_pairs` for a `Library_element_reference`.

#### **4.2.56 Library\_property\_and\_property\_value**

A `Library_property_and_property_value` specifies a property (see ISO13584-24 for definition of property) and its value.

The data associated with a `Library_property_and_property_value` are the following:

- `property_identifier`;
- `property_value`;
- `qualifier`.

##### **4.2.56.1 property\_identifier**

The `property_identifier` specifies the identification information for type of property by reference to a `Property_BSU` (see 4.2.91).

##### **4.2.56.2 property\_value**

The `property_value` specifies the type of the value assigned to the property.

##### **4.2.56.3 qualifier**

The `qualifier` is a text that provides extra information for the `Library_property_and_property_value`. The `qualifier` need not be specified for a particular `Library_property_and_property_value`.

#### **4.2.57 Linear\_damping\_coefficient**

A `Linear_damping_coefficient` is a type of `Measure_with_unit` (see 4.2.64) where the physical quantity is linear damping coefficient. In an oscillating system subject to viscous damping, the linear damping coefficient is defined as the force resisting the motion per unit velocity.

A data associated with a `Linear_damping_coefficient` are the following:

- `linear_damping_coefficient_unit`.

The `linear_damping_coefficient_unit` specifies all the units that can be used for quantifying the linear damping coefficient.

#### **4.2.58 Linear\_stiffness**

A `Linear_stiffness` is a type of `Measure_with_unit` (see 4.2.64) where the physical quantity is the material stiffness. In a mechanical vibrating system, linear stiffness is the restoring force per unit length deflection.

A data associated with a `Linear_stiffness` are the following:

- `linear_stiffness_unit`.

The `linear_stiffness_unit` specifies all the units that can be used for quantifying the linear stiffness.

#### **4.2.59 Local\_time**

A `local_time` specifies the value of the local time. It is used as defined in ISO 10303-41.

#### **4.2.60 Logical\_value**

The `Logical_value` specifies that the property value is of type logical.

The data associated with a `Logical_value` are the following:

— `the_value`.

The `the_value` specifies the actual value of the property in the form of a logical value (true or false).

#### **4.2.61 Mass**

A `Mass` is a type of `Measure_with_unit` (see 4.2.64) where the physical quantity is a mass as defined in ISO 31 (clause 2).

The data associated with a `Mass` are the following:

— `mass_unit`.

The `mass_unit` specifies all the units which can be used for mass.

#### **4.2.62 Mass\_flow**

A `Mass_flow` is a type of `Measure_of_unit` (see 4.2.64) where the physical quantity is the mass flow.

The data associated with an `Mass_flow` are the following:

— `mass_flow_unit`.

The `mass_flow_unit` specifies all the engineering units which can be used for mass flow.

#### **4.2.63 Material**

A `Material` is a type of `Item` (see 4.2.50) that specifies the general data that are attributable to all types of materials.

The data associated with a `Material` are the following:

— `material_code`

The `material_code` attribute specifies an identification code for the material in the form of a label. A `material_code` need not be specified for a particular `Material`.

#### **4.2.64 Measure\_with\_unit**

A `Measure_with_unit` is the specification of a physical quantity as defined in ISO 31 (clause 2). Each `Measure_with_unit` may be one of the following: a `Density` (see 4.2.24), a `Dilatation` (see 4.2.27), an `Electrical_current` (see 4.2.31), an `Energy` (see 4.2.32), and `Energy_per_mass` (see 4.2.33), a `Force` (see 4.2.41), a `Frequency` (see 4.2.42), a `Heat_capacity` (see 4.2.47), an `Inertia_moment` (see 4.2.48), a `Length` (see 4.2.53), a `Linear_damping_coefficient` (see 4.2.57), a `Linear_stiffness` (see 4.2.58), a `Mass` (see 4.2.61), a `Mass_flow` (see 4.2.62), a `Molecular_weight` (see 4.2.69), a `Plane_angle` (see 4.2.76), a

Power (see 4.2.78), a Pressure (see 4.2.79), a Ratio (see 4.2.92), a Rotational\_damping\_coefficient (see 4.2.96), a Rotational\_speed (see 4.2.97), a Rotational\_stiffness (see 4.2.98), a Specific\_fuel\_consumption (see 4.2.115), a Speed (see 4.2.116), a Stress (see 4.2.117), a Surface\_tension (see 4.2.120), a Temperature (see 4.2.123), a Thermal\_conductivity (see 4.2.124), a Time (see 4.2.126), a Torque (see 4.2.129), a Viscosity (see 4.2.130), a Voltage (see 4.2.131) or a Volume\_flow (see 4.2.132).

The data associated with a Measure\_with\_unit are the following:

- measure\_value;
- qualifier.

#### **4.2.64.1      measure\_value**

The measure\_value specifies the value of the physical quantity when expressed in the specified units.

#### **4.2.64.2      qualifier**

The qualifier specifies additional information in text format which describes the scope of the value. Aspects such as normalisation, correction, averaging, measured/predicted/estimated can be specified using the qualifier attribute.

### **4.2.65      Mechanical\_product**

A Mechanical\_product is a type of Dictionary\_item (see 4.2.26) that provides the high level concept for all the mechanical products (see 3.7.35) which need to be defined or described.

The data associated with a Mechanical\_product are the following:

- ship\_context.

The ship\_context specifies the context of the mechanical product in terms of its applicability or belonging to a ship. The ship\_context need not be specified for a particular Mechanical\_product.

### **4.2.66      Mechanical\_product\_drawing**

A Mechanical\_product\_drawing is a type of Mechanical\_product\_representation (see 4.2.67) that specifies the geometric representation of mechanical product in the form of one to many CAD drawings together with identification of the drawing configuration.

The data associated with a Mechanical\_product\_drawing are the following:

- defined\_for;
- drawing;
- external\_reference\_drawing.

#### **4.2.66.1      defined\_for**

The defined\_for specifies a set of one to many mechanical products for which drawing is defined.

#### **4.2.66.2      drawing**

The drawing attribute specifies the detailed representation of mechanical product in the form of a CAD drawing. This is supported through use of a `Geometric_representation_item` (see 4.2.43) as defined in ISO 10303-42. There may be more than one drawing for a `Mechanical_product_drawing`.

#### **4.2.66.3 external\_reference\_drawing**

The `external_reference_drawing` specifies the product drawing by specifying a set of external drawings. There may be more than one `external_reference_drawing` for a `Mechanical_product_drawing`.

### **4.2.67 Mechanical\_product\_representation**

A `Mechanical_product_representation` is a type of Definition (see 4.2.22) and specifies the concept for detailed geometry of a mechanical product. Within this part of ISO 10303 each `Mechanical_product_representation` is either a `Mechanical_product_shape_representation` (see 4.2.68) or a `Mechanical_product_drawing` (see 4.2.66).

### **4.2.68 Mechanical\_product\_shape\_representation**

A `Mechanical_product_shape_representation` is a type of `Mechanical_product_representation` (see 4.2.67) and specifies the external shape of a mechanical product.

The data associated with a `Mechanical_product_shape_representation` are the following:

- `defined_for`;
- `external_reference_shape_representation`;
- `plib_shape_representation`;
- `shape_solid`.

#### **4.2.68.1 defined\_for**

The `defined_for` specifies a set of one to many mechanical products for which shape is defined.

#### **4.2.68.2 external\_reference\_shape\_representation**

The `external_reference_shape_representation` specifies a set of, if any, externally defined shapes for the mechanical product using the external referencing mechanism. There may be more than one `external_reference_shape_representation` for a `Mechanical_product_shape_representation`.

#### **4.2.68.3 plib\_shape\_representation**

The `plib_shape_representation` specifies a set of, if any, externally defined shapes for the mechanical product via reference to an ISO 13548 compliant external library. There may be more than one `plib_shape_representation` for a particular `Mechanical_product_shape_representation`.

#### **4.2.68.4 shape\_solid**

The `shape_solid` specifies the external shape representation of the mechanical product in the form of a solid model (see 3.7.50). The shape representation is supported by `Solid_model` (see 4.2.113). There may be more than one `shape_solid` for a `Mechanical_product_shape_representation`.

### **4.2.69 Molecular\_weight**

A `Molecular_weight` is a type of `Measure_with_unit` (see 4.2.64) where the physical quantity is the molecular weight.

The data associated with a `Molecular_weight` are the following:

— `molecular_weight_unit`.

The `molecular_weight_unit` specifies all the engineering units which can be used for molecular weight.

#### **4.2.70    `Number_value`**

The `Number_value` specifies that the property value is of type number.

The data associated with a `Number_value` are the following:

— `the_value`.

The `the_value` specifies the actual value of the property in the form of a number (integer or real number).

#### **4.2.71    `Ordinal_date`**

An `Ordinal_date` specifies day in a year. It is used as defined in ISO 10303-41.

#### **4.2.72    `Organization`**

An `Organization` specifies the details of the referenced organisation. It is used as defined in ISO 10303-41.

#### **4.2.73    `Organizational_project`**

An `Organizational_project` specifies the details of the referenced project. It is used as defined in ISO 10303-41.

#### **4.2.74    `Person`**

A `Person` specifies the details of a person which needs to be identified. It is used as defined in ISO 10303-41.

#### **4.2.75    `Person_and_organization`**

A `Person_and_organization` specifies the details of a person and his/her affiliated organisation. It is used as defined in ISO 10303-41.

#### **4.2.76    `Plane_angle`**

A `Plane_angle` is a type of `Measure_with_unit` (see 4.2.64) where the physical quantity is a plane angle as defined in ISO 31 (clause 2).

The data associated with a `Plane_angle` are the following:

— `plane_angle_unit`.

The `plane_angle_unit` specifies all the units in which plane angles are measured.

#### **4.2.77 Part\_library\_defined\_shape\_representation**

A `Part_library_defined_shape_representation` specifies a mechanical product shape representation as defined in an ISO 13584 compliant data library.

The data associated with a `Part_library_defined_shape_representation` are the following:

- `axis2_placement`;
- `library_element`.

##### **4.2.77.1 axis2\_placement**

The `axis2_placement` specifies the shape representation according to ISO 13584.

##### **4.2.77.2 library\_element**

The `library_element` specifies a `Library_element_reference` (see 4.2.55) which contains the complete set of information for referencing an instance of a mechanical product in an ISO 13584 compliant data library.

#### **4.2.78 Power**

A `Power` is a type of `Measure_with_unit` (see 4.2.64) where the physical quantity is power (energy per time).

The data associated with a `Power` are the following:

- `power_unit`.

The `power_unit` specifies all the units in which the physical quantity of power is measured.

#### **4.2.79 Pressure**

A `Pressure` is a type of `Measure_with_unit` (see 4.2.64) where the physical quantity is pressure (force per area).

The data associated with a `Pressure` are the following:

- `pressure_unit`.

The `pressure_unit` specifies all the units in which the physical quantity of pressure is measured.

#### **4.2.80 Principal\_characteristics**

The `Principal_characteristics` is a type of `Ship_general_characteristic` (see 4.2.107) and specifies the main shape parameters of the hull moulded form. `Principal_characteristics` also includes data that is required in subsequent iterations of the hull development process when one is considering hydrostatics.

The data associated with a `Principal_characteristics` are the following:

- `block_coefficient`;

- design\_deadweight;
- design\_draught;
- gross\_tonnage;
- length\_between\_perpendiculars;
- mass\_measure;
- max\_draught\_at\_AP;
- max\_draught\_at\_FP;
- min\_draught\_at\_AP;
- min\_draught\_at\_FP;
- moulded\_breadth;
- moulded\_depth.

#### **4.2.80.1 block\_coefficient**

The block\_coefficient specifies the ratio of the moulded displacement volume to the volume of a block that has its length equal to the length\_between\_perpendiculars, its breadth equal to the maximum immersed moulded\_breadth and its depth equal to the design\_draught. The block\_coefficient should be defined only for mono hull ships.

#### **4.2.80.2 defined\_for**

The defined\_for specifies a set of one to many ships for which principal characteristics are defined.

#### **4.2.80.3 design\_deadweight**

The design\_deadweight specifies the weight of the ship representing the weight of cargo, bunker fuel, water, passengers, crew and consumables which a ship can carry when loaded to her summer load line.

#### **4.2.80.4 design\_draught**

The design\_draught specifies the optimal draught to which the ship has been designed to operate.

#### **4.2.80.5 gross\_tonnage**

The gross\_tonnage specifies the total weight of the ship while fully loaded.

#### **4.2.80.6 length\_between\_perpendiculars**

The length\_between\_perpendiculars specifies the length measured from the after perpendicular to the forward perpendicular of the ship.

#### **4.2.80.7 max\_draught\_at\_AP**

The max\_draught\_at\_AP specifies the maximum possible draught at the Aft Perpendicular during the operation of the ship. The max\_draught\_at\_AP is used for at hull cross section approval for the ice class notation.

#### **4.2.80.8 max\_draught\_at\_FP**

The max\_draught\_at\_FP specifies the maximum possible draught at the Forward Perpendicular during the operation of the ship. The max\_draught\_at\_FP is used at hull cross section approval for the ice class notation.



#### **4.2.80.9 min\_draught\_at\_AP**

The min\_draught\_at\_AP specifies the minimum possible draught at the Aft Perpendicular during the operation of the ship. The min\_draught\_at\_AP is used at hull cross section approval for the ice class notation.

#### **4.2.80.10 min\_draught\_at\_FP**

The min\_draught\_at\_FP specifies the minimum possible draught at the Forward Perpendicular during the operation of the ship. The min\_draught\_at\_FP is used at hull cross section approval for the ice class notation.

#### **4.2.80.11 moulded\_breadth**

The moulded\_breadth specifies the maximum breadth of the ship amidships and at the design\_draught.

#### **4.2.80.12 moulded\_depth**

The moulded\_depth specifies the vertical distance above the baseline to the uppermost deck where the deck joins the side of the ship measured amidships.

### **4.2.81 Product\_anomaly**

A Product\_anomaly is a type of Dictionary\_item (see 4.2.26) that specifies the high level concept for representing all types of anomalies (see 3.7.3) that need to be defined.

### **4.2.82 Product\_assemblage**

A Product\_assemblage is a type of Product\_structure\_definition (see 4.2.89) that specifies the information which defines the way the mechanical product is assembled.

The data associated with a Product\_assemblage are the following:

- assembled\_items\_relationships;
- defined\_for;
- method\_of\_assembly.

#### **4.2.82.1 assembled\_items\_relationships**

The assembled\_items\_relationships specifies all the relationships between the constituent items of the mechanical product. There may be more than one assembled\_items\_relationships for a Product\_assemblage.

#### **4.2.82.2 defined\_for**

The defined\_for specifies a set of one to many mechanical products for which assembly data are defined.

#### **4.2.82.3 method\_of\_assembly**

The method\_of\_assembly specifies the information which describes the method of assembly and disassembly in the form of a set of documents, if any. There may be more than one

method\_of\_assembly for a Product\_assemblage.

## **4.2.83 Product\_composition**

A Product\_composition is a type of Product\_structure\_definition (see 4.2.89) that specifies the high level concept for all the definitions which relate to the composition (see 3.7.10) of a mechanical product.

The data associated with a Product\_composition are the following:

- composed\_of;
- defined\_for.

### **4.2.83.1 composed\_of**

The composed\_of specifies a set of mechanical products which are members of composition (see 3.7.10) for this mechanical product. There may be more than one composed\_of for a Product\_composition.

### **4.2.83.2 defined\_for**

The defined\_for specifies a set of one to many mechanical products for which product composition is defined.

## **4.2.84 Product\_connection**

A Product\_connection is a type of Product\_relationship (see 4.2.87) and specifies the high level concept for all the definitions which relate to connection (see 3.7.13) of a mechanical product to another item.

The data associated with a Product\_connection are the following:

- connecting\_components;
- connector\_components;
- documentation.

### **4.2.84.1 connecting\_components**

The connecting\_components specifies all the connecting components (see 3.7.12) required in order to realise a connection. There may be more than one connecting\_components for a Product\_connection.

### **4.2.84.2 connector\_components**

The connector\_components specifies all the connectors (see 3.7.14) for this connection. There may be more than one connector\_component for a Product\_connection.

### **4.2.84.3 documentation**

The documentation specifies all the operational and functional characteristics for the connection as well as manuals describing how to realise the connection. There may be more than one documentation for a Product\_connection.

### 4.2.85 Product\_connectivity

A Product\_connectivity is a type of Product\_structure\_definition (see 4.2.89) that specifies the concept for all the definitions which relate to product connectivity of a mechanical product.

The data associated with a Product\_connectivity are the following:

- defined\_for;
- product\_connections;
- product\_connectivity\_specifications.

#### 4.2.85.1 defined\_for

The defined\_for specifies a set of one to many mechanical products for which connectivity data are defined.

#### 4.2.85.2 product\_connections

The product\_connections specifies a set of, if any, all types of connection for the product by referencing the Product\_connection (see 4.2.84) application object. There may be more than one product\_connections for a particular Product\_connectivity.

#### 4.2.85.3 product\_connectivity\_specifications

The product\_connectivity\_specifications specifies a set of, if any, documents that define the overall specification of the product connections. There may be more than one product\_connectivity\_specifications for a Product\_connectivity.

### 4.2.86 Product\_participation

A Product\_participation is a type of Product\_structure\_definition (see 4.2.89) that specifies the high level concept for all the definitions which relate to the belonging of a mechanical product to another higher level mechanical product in the decomposition hierarchy (see 3.7.16).

The data associated with a Product\_participation are the following:

- defined\_for;
- product\_is\_part\_of.

#### 4.2.86.1 defined\_for

The defined\_for specifies a set of one to many mechanical products for which participation data are defined.

#### 4.2.86.2 product\_is\_part\_of

The product\_is\_part\_of specifies the higher level mechanical product, in the decomposition hierarchy, part of which this mechanical product is.

### 4.2.87 Product\_relationship

A Product\_relationship is a type of Item\_relationship (see 4.2.51) that defines the relationship and association between two mechanical products.

#### **4.2.88 Product\_space\_site\_relationship**

A Product\_space\_site\_relationship is a type of Item\_relationship (see 4.2.51) that defines the relationship and association between the site and space requirement for storing a mechanical product.

#### **4.2.89 Product\_structure\_definition**

A Product\_structure\_definition is a type of Definition (see 4.2.22) and specifies the high level concept for all the definitions (see 3.7.17) which are attributable to product structure (see 3.7.43). Within this part of ISO 10303 each Product\_structure\_definition is either a Product\_assemblage (see 4.2.82), a Product\_composition (see 4.2.83), a Product\_connectivity (see 4.2.85), or a Product\_participation (see 4.2.86).

#### **4.2.90 Product\_task\_relationship**

A Product\_task\_relationship is a type of Item\_relationship (see 4.2.51) that defines the relationship and association between a mechanical product and a task.

#### **4.2.91 Property\_BSU**

A Property\_BSU is a type of Basic\_semantic\_unit (see 4.2.7) and specifies the identification information for referencing of a property in an ISO 13584 compliant data dictionary.

The data associated with a Property\_BSU are the following:

— name\_scope.

The name\_scope specifies the corresponding Class\_BSU (see 4.2.12) to which the property is assigned. The name\_scope need not be specified for a particular Property\_BSU.

#### **4.2.92 Ratio**

A Ratio is a type of Measure\_with\_unit (see 4.2.64) where the physical quantity is a ratio as defined in ISO 31 (clause 2).

The data associated with a Ratio are the following:

— ratio\_unit.

The ratio\_unit attribute specifies all the units in which the ratio of the two physical quantities is measured.

#### **4.2.93 Real\_value**

The real\_value specifies that the property value is of type real number.

The data associated with a Real\_value are the following:

— the\_value.

The the\_value specifies the actual value of the property in the form of a real number (a number with a floating point).

#### 4.2.94 **Restricted\_water**

A **Restricted\_water** is a type of **Item** (see 4.2.50) and specifies the concept for defining a restricted water area such as rivers and canals where ship passes through during its voyage.

#### 4.2.95 **Revision**

A **Revision** specifies a collection of definitional entities that together are the subject of a version control.

The data associated with a **Revision** are the following:

- **context\_item**;
- **definition\_relationships**;
- **members**;
- **name**;
- **reason**.

##### 4.2.95.1 **context\_item**

The **context\_item** specifies the main context, such as the mechanical product, for a revision.

##### 4.2.95.2 **definition\_relationships**

The **definition\_relationships** specify a set of zero to many **Definition\_relationship** (see 4.2.23) that together are a part of a revision. There may be more than one **definition\_relationships** for a **Revision**.

##### 4.2.95.3 **members**

The **members** attribute specifies a set of zero to many **Definition** (see 4.2.22) that together are part of a revision. There may be more than one **members** for a **Revision**.

##### 4.2.95.4 **name**

The **name** specifies, as text, a user identifiable name for the revision.

##### 4.2.95.5 **reason**

The **reason** specifies, as text, the reason for creating the revision. The reason need not be specified for a particular **Revision**.

#### 4.2.96 **Rotational\_damping\_coefficient**

A **Rotational\_damping\_coefficient** is a type of **Measure\_with\_unit** (see 4.2.64) where the physical quantity is rotational damping coefficient. In a rotating system subject to viscous damping, the rotational damping coefficient is defined as the torque resisting the motion per unit angular velocity.

A data associated with a **Rotational\_damping\_coefficient** are the following:

- **rotational\_damping\_coefficient\_unit**.

The **rotational\_damping\_coefficient\_unit** specifies all the units that can be used for quantifying the rotational damping coefficient.

#### **4.2.97 Rotational\_speed**

A Rotational\_speed is a type of Measure\_with\_unit (see 4.2.64) where the physical quantity is the speed of rotation.

The data associated with a Rotational\_speed are the following:

— rotational\_speed\_unit.

The rotational\_speed\_unit specifies all the units for the rotational speed.

#### **4.2.98 Rotational\_stiffness**

A Rotational\_stiffness is a type of Measure\_with\_unit (see 4.2.64) where the physical quantity is the material rotational stiffness. In a mechanical vibrating system, rotational stiffness is the restoring torque per unit angular deflection.

A data associated with a Rotational\_stiffness are the following:

— rotational\_stiffness\_unit.

The rotational\_stiffness\_unit specifies all the units that can be used for quantifying the rotational stiffness.

#### **4.2.99 Sea**

A Sea is a type of Item (see 4.2.50) and specifies the concept for defining a sea or an ocean within the context of this part of ISO 10303.

#### **4.2.100 Sea\_port**

A Sea\_port is a type of Item (see 4.2.50) and specifies the concept for defining sea ports and harbours where the ship stays during its voyage.

The data associated with a Sea\_port are the following:

— port\_name.

The port\_name specifies the name and descriptive details of the port.

#### **4.2.101 Ship**

A Ship is a type of Item (see 4.2.50) that specifies the ship concerned. All data defining the product must be related to a ship, which might exist in any life cycle stage.

The data associated with a Ship are the following:

— ship\_type.

The ship\_type specifies, as text, the type of the ship.

#### **4.2.102 Ship\_at\_port**

A Ship\_at\_port specifies information about a ship voyage in relation to its port visits and stays.

The data associated with a Ship\_at\_port are the following:

- delay;
- sea\_port;
- schedule\_at\_port.

#### **4.2.102.1 delay**

The delay specifies time spent in the port in excess of the planned time.

#### **4.2.102.2 sea\_port**

The sea\_port specifies a particular Sea\_port (see 4.2.100) where the ship is visiting or staying.

#### **4.2.102.3 schedule\_at\_port**

The schedule\_at\_port specifies a Time\_schedule (see 4.2.128), representing the schedule that the ship is expected to follow, or has actually followed, during its stay at a port.

### **4.2.103 Ship\_at\_restricted\_water**

A Ship\_at\_restricted\_water specifies information about a ship voyage in relation to its journey through a Restricted\_water (see 4.2.94).

The data associated with a Ship\_at\_restricted\_water are the following:

- delay;
- restricted\_water;
- schedule\_at\_restricted\_water.

#### **4.2.103.1 delay**

The delay specifies time spent in restricted water area in excess of planned time.

#### **4.2.103.2 restricted\_water**

The restricted\_water specifies a particular Restricted\_water (see 4.2.94) area where the ship is travelling through.

#### **4.2.103.3 schedule\_at\_restricted\_water**

The schedule\_at\_restricted\_water specifies a Time\_schedule (see 4.2.128) that the ship is expected to follow, or has actually followed, during its journey at restricted water area.

### **4.2.104 Ship\_at\_sea**

A Ship\_at\_sea specifies information about a ship voyage in relation to its journey at a specific Sea (see 4.2.99).

The data associated with a Ship\_at\_sea are the following:

- delay;

- schedule\_at\_sea;
- sea.

#### **4.2.104.1 delay**

The delay specifies time spent at sea in excess of planned time.

#### **4.2.104.2 schedule\_at\_sea**

The schedule\_at\_sea specifies a Time\_schedule (see 4.2.128) that the ship is expected to follow, or has actually followed, during its journey at sea.

#### **4.2.104.3 sea**

The sea specifies a particular Sea (see 4.2.99) where the ship is making its journey.

### **4.2.105 Ship\_at\_shipyard**

A Ship\_at\_shipyard specifies information about a ship voyage in relation to its visits or stays at a Shipyard (see 4.2.111).

The data associated with a Ship\_at\_shipyard are the following:

- delay;
- schedule\_at\_shipyard;
- shipyard.

#### **4.2.105.1 delay**

The delay specifies time spent at a shipyard in excess of planned time.

#### **4.2.105.2 schedule\_at\_shipyard**

The schedule\_at\_shipyard specifies a Time\_schedule ( see 4.2.128) that the ship is expected to follow, or has actually followed, during the stay at a shipyard.

#### **4.2.105.3 shipyard**

The shipyard specifies a particular Shipyard (see 4.2.111) where the ship is visiting or staying.

### **4.2.106 Ship\_designation**

A Ship\_designation is a type of Ship\_general\_characteristic (see 4.2.107) and specifies the identification given to the ship in order that it can be categorised by any shipping related organisation.

The data associated with a Ship\_designation are the following:

- call\_sign;
- date\_placed\_in\_service;
- defined\_for;
- flag\_state;
- port\_of\_registration;
- ship\_classifier;
- ship\_identification;



- ship\_name;
- ship\_operator;
- ship\_owner;
- ship\_type\_description.

#### **4.2.106.1 call\_sign**

The call\_sign specifies the unique lifecycle identifier assigned to the ship by the flag\_state for radio communication.

#### **4.2.106.2 date\_placed\_in\_service**

The date\_placed\_in\_service specifies the date when the ship first went into service. The date\_placed\_in\_service need not be specified for a particular Ship\_designation.

#### **4.2.106.3 defined\_for**

The defined\_for specifies a set of one to many ships for which the ship designation data are defined.

#### **4.2.106.4 flag\_state**

The flag\_state specifies the national authority with whom the ship is registered.

#### **4.2.106.5 port\_of\_registration**

The port\_of\_registration specifies the national home port of the ship. The port\_of\_registration lies within the jurisdiction of the flag\_state.

#### **4.2.106.6 ship\_classifier**

The ship\_classifier specifies details of the classification society under which the ship is currently classed. The ship\_classifier need not be specified for a particular Ship\_designation.

#### **4.2.106.7 ship\_identification**

The ship\_identification specifies a general identifier unique to the ship, as text, as assigned during the classification process.

#### **4.2.106.8 ship\_name**

The ship\_name specifies the owner assigned name of the ship.

#### **4.2.106.9 ship\_operator**

The ship\_operator specifies details of the current operator of the ship. The ship\_operator need not be specified for a particular Ship\_designation.

#### **4.2.106.10 ship\_owner**

The ship\_owner specifies details of the current owner of the ship. The ship\_owner need not be specified for a particular Ship\_designation.

#### **4.2.106.11 ship\_type\_description**

The ship\_type\_description specifies more details about the function of the ship and additional information about the cargo carried.

#### **4.2.107 Ship\_general\_characteristics**

A Ship\_general\_characteristics is a type of Definition (see 4.2.22) and specifies the concept for representation of data that are attributable to general characteristics of the ship.

#### **4.2.108 Ship\_operation\_characteristics**

A Ship\_operation characteristic is a type of Ship\_general\_characteristics and specifies the operational mode of the ship.

The data associated with a Ship\_operation\_characteristic are the following:

- defined\_for;
- ship\_operation\_mode.

##### **4.2.108.1 defined\_for**

The defined\_for specifies a set of one to many ships for which overall dimensions are defined.

##### **4.2.108.2 ship\_operation\_mode**

The ship\_operation\_mode specifies the ship operation condition.

The value of Ship\_operation\_mode shall be one of the following:

- at\_anchor;
- dry\_dock;
- port\_operation;
- steaming;
- user\_defined\_ship\_operation\_mode.

**4.2.108.2.1 at\_anchor:** the descriptor that specifies the ship to be at anchor.

**4.2.108.2.2 dry\_dock:** the descriptor that specifies the ship to be at dry dock.

**4.2.108.2.3 port\_operation:** the descriptor that specifies the ship is operating at the port.

**4.2.108.2.4 steaming:** the descriptor that specifies the ship is under normal operating condition at sea.

**4.2.108.2.5 user\_defined\_ship\_operation\_mode:** the descriptor, set by the user, that specifies the operation mode of the ship if different from other options.

#### **4.2.109 Ship\_overall\_dimension**

A Ship\_overall\_dimension specifies the maximum limits of the ship moulded form.

The data associated with Ship\_overall\_dimensions are the following:

- defined\_for;
- stem\_overhang;

— stern\_overhang.

#### **4.2.109.1 defined\_for**

The defined\_for specifies a set of one to many ships for which overall dimensions are defined.

#### **4.2.109.2 stem\_overhang**

The stem\_overhang specifies the length from the forward perpendicular to the extreme forward end of ship moulded form.

#### **4.2.109.3 stern\_overhang**

The stern\_overhang specifies the length from the extreme aft end of the ship moulded form to the after perpendicular.

### **4.2.110 Ship\_voyage**

A Ship\_voyage is a type of Definition (see 4.2.22) and specifies all the information about a ship voyage including route, port visits and corresponding schedule and delays.

The data associated with a Ship\_voyage are the following:

- at\_port;
- at\_restricted\_water;
- at\_sea;
- at\_shipyard;
- defined\_for;
- voyage\_delays;
- voyage\_schedule.

#### **4.2.110.1 at\_port**

The at\_port specifies a set of zero to many Ship\_at\_port (see 4.2.102) that define all the ports visited by the ship along its route. There may be more than one at\_port for a Ship\_voyage.

#### **4.2.110.2 at\_restricted\_water**

The at\_restricted\_water specifies a set of zero to many Ship\_at\_restricted\_water (see 4.2.103) that define all the restricted water areas through which the ship has travelled. There may be more than one at\_restricted\_water for a Ship\_voyage.

#### **4.2.110.3 at\_sea**

The at\_sea specifies a set of zero to many Ship\_at\_sea (see 4.2.104) that define the route and schedule for the ship voyage in open sea or ocean. There may be more than one at\_sea for a Ship\_voyage.

#### **4.2.110.4 at\_shipyard**

The at\_shipyard specifies a set of zero to many Ship\_at\_shipyard (see 4.2.105) that define all the shipyards visited by the ship along its journey. There may be more than one at\_shipyard for a Ship\_voyage.

#### **4.2.110.5 defined\_for**

The defined\_for specifies a set of one to many ships for which ship voyage is defined.

#### **4.2.110.6 voyage\_delays**

The voyage\_delays specifies time spent on a voyage in excess of planned time. The voyage\_delays need not be specified for a particular Ship\_voyage

#### **4.2.110.7 voyage\_schedule**

The voyage\_schedule specifies a Time\_schedule ( see 4.2.128) that the ship is expected to follow, or has actually followed, during the voyage. The voyage\_schedule need not be specified for a particular Ship\_voyage.

### **4.2.111 Shipyard**

A Shipyard is a type of Item (see 4.2.50) and specifies the concept for defining a shipyard within the context of this part of ISO 10303.

The data associated with a Shipyard are the following:

- shipyard\_name.

The shipyard\_name specifies the name and description details of the shipyard.

#### **4.2.112 Shipyard\_designation**

A Shipyard\_designation is a type of Ship\_general\_characteristic (see 4.2.107) and specifies the identification given to the ship by the shipbuilder.

The data associated with a Shipyard\_designation are the following:

- defined\_for;
- role;
- shipyard;
- shipyard\_new\_building\_id;
- shipyard\_project\_name.

##### **4.2.112.1 defined\_for**

The defined\_for specifies a set of one to many ships for which the shipyard designation has been defined.

##### **4.2.112.2 role**

The role specifies the contractual obligation the shipyard has in relation to the ship.

The value of Shipyard\_role shall be one of the following:

- prime\_design;
- prime\_build;
- prime\_repair;
- prime;

— subcontractor.

**4.2.112.2.1 prime\_design:** the prime contractor, with contract responsibility for the design of the ship.

**4.2.112.2.2 prime\_build:** the prime contractor, with contract responsibility for the manufacture of the ship.

**4.2.112.2.3 prime\_repair:** the prime contractor, with contract responsibility for the repair of the ship.

**4.2.112.2.4 prime:** the prime contractor for the ship.

**4.2.112.2.5 subcontractor:** the subcontractor for the ship.

### **4.2.112.3 shipyard**

The shipyard specifies the name and organisational details of the shipyard.

#### **4.2.112.4 shipyard\_new\_building\_id**

The shipyard\_new\_building\_id specifies an identifier for the ship that is assigned by the shipyard after an order has been confirmed.

#### **4.2.112.5 shipyard\_project\_name**

The shipyard\_project name specifies an identifier for the ship that is assigned by the shipyard on receipt of an order, or tender, for a new ship.

### **4.2.113 Solid\_model**

A Solid\_model is a complete representation of the nominal shape of a product such that all points in the interior are connected. Any point can be classified as being inside, outside or on the boundary of a solid. It is used as defined in ISO 10303-41.

#### **4.2.114 Space\_site**

A Space\_site is a type of Item (see 4.2.50) that specifies the high level concept for data representation for all various spaces or sites that are related to ships.

#### **4.2.115 Specific\_fuel\_consumption**

A Specific\_fuel\_consumption is a type of Measure\_with\_unit (see 4.2.64) where the physical quantity is the rate at which fuel is consumed to produce a unit of power or thrust. The specific fuel consumption is a measure of thermodynamic performance of combustion engines.

A data associated with a Specific\_fuel\_consumption are the following:

— specific\_fuel\_consumption\_unit.

The specific\_fuel\_consumption\_unit specifies all the units that can be used for quantifying the specific fuel consumption.

#### **4.2.116 Speed**

A Speed is a type of Measure\_with\_unit (see 4.2.64) where the physical quantity is linear speed.

The data associated with a Speed are the following:

- speed\_unit.

The speed\_unit specifies all the units in which linear speed is measured.

#### **4.2.117 Stress**

A Stress is a type of Measure\_with\_unit (see 4.2.64) where the physical quantity is the stress within a material.

The data associated with a Stress are the following:

- stress\_unit.

The stress\_unit specifies all the units in which the physical quantity of stress is measured.

#### **4.2.118 String\_value**

The String\_value specifies that the property value is of type string.

The data associated with a String\_value are the following:

- the\_value.

The the\_value specifies the actual value of the property in the form of a string (a text).

#### **4.2.119 Supplier\_BSU**

A Supplier\_BSU is a type of Basic\_semantic\_unit (see 4.2.7) and specifies the identification information for referencing a supplier of an ISO 13584 compliant data library.

#### **4.2.120 Surface\_tension**

A Surface\_tension is a type of Measure\_with\_unit (see 4.2.64) where the physical quantity is surface tension of a liquid.

The data associated with a Surface\_tension are the following:

- surface\_tension\_unit.

The surface\_tension\_unit specifies all the units in which the physical quantity of force per length is measured.

#### **4.2.121 Task**

A Task is a type of Dictionary\_item (see 4.2.26) that specifies the high level concept for data representation for all various tasks (see 3.7.52) and activities that need to be defined.

#### **4.2.122 Task\_relationship**

A Task\_relationship is a type of Item\_relationship (see 4.2.51) that specifies the high level concept for relating two tasks together.

### **4.2.123 Temperature**

A Temperature is a type of Measure\_with\_unit (see 4.2.64) where the physical quantity is temperature as defined in ISO 31 (clause 2).

The data associated with a Temperature are the following:

— temperature\_unit.

The temperature\_unit specifies all the units in which the temperature is measured.

### **4.2.124 Thermal\_conductivity**

A Thermal\_conductivity is a type of Measure\_with\_unit (see 4.2.64) where the physical quantity is thermal conductivity.

The data associated with a Thermal\_conductivity are the following:

— thermal\_conductivity\_unit.

The thermal\_conductivity\_unit specifies all the units in which the physical quantity of thermal conductivity is measured.

### **4.2.125 Text**

A Text application object is used to assign a character text in order to describe something. It is used as defined in ISO 10303-41.

### **4.2.126 Time**

A Time is a type of Measure\_with\_unit (see 4.2.64) where the physical quantity is time as defined in ISO 31 (clause 2).

The data associated with a Time are the following:

— time\_unit.

The time\_unit specifies all the units in which the duration of periods is measured.

### **4.2.127 Time\_role**

A Time\_role specifies additional description for the use of time. It is used as defined in ISO 10303-41.

### **4.2.128 Time\_schedule**

A Time\_schedule specifies a time schedule in terms of its start and end dates, and its duration.

The data associated with a Time\_schedule are the following:

- duration;
- end\_date\_time;
- start\_date\_time.

#### **4.2.128.1 duration**

The duration specifies the time duration of the event.

#### **4.2.128.2 end\_date**

The end\_date specifies the end date for the time period.

#### **4.2.128.3 start\_date**

The start\_date specifies the start date for the time period.

### **4.2.129 Torque**

A Torque is a type of Measure\_with\_unit (see 4.2.64) where the physical quantity is Torque.

The data associated with a Torque are the following:

- torque\_unit.

The torque\_unit specifies all the units for torque.

### **4.2.130 Viscosity**

A Viscosity is a type of Measure\_with\_unit (see 4.2.64) where the physical quantity is kinematic viscosity of the fluid.

The data associated with a Viscosity are the following:

- viscosity\_unit.

The viscosity\_unit specifies all the units in which the physical quantity of area per time is measured.

### **4.2.131 Voltage**

A Voltage is a type of Measure\_with\_unit (see 4.2.64) where the physical quantity is the voltage.

The data associated with a Voltage are the following:

- voltage\_unit.

The voltage\_unit specifies all the engineering units which can be used for voltage.

### **4.2.132 Volume\_flow**

A Volume\_flow is a type of Measure\_with\_unit (see 4.2.64) where the physical quantity is the volume flow.



The data associated with a Volume\_flow are the following:

— volume\_flow\_unit.

The volume\_flow\_unit specifies all the engineering units which can be used for volume flow.

#### **4.2.133 Week\_of\_year\_and\_day\_date**

A Week\_of\_year\_and\_day\_date specifies a week in a year and a day within that week. It is used as defined in ISO 10303-41.

## **4.3 Application Assertions**

This subclause specifies the application assertions for the ship mechanical systems application protocol. Application assertions specify the relationships between application objects, the cardinality of relationships, and the rules required for the integrity and validity of the application objects and UoFs. The application assertions and their definitions are given below.

### **4.3.1 Class\_BSU to Supplier\_BSU**

Each Class\_BSU refers to exactly one Supplier\_BSU. A Supplier\_BSU defines the delivered\_by for Class\_BSU.

### **4.3.2 External\_drawing to CAD\_system**

Each External\_drawing refers to exactly one CAD\_system. A CAD\_system defines the CAD\_system\_details for External\_drawing.

### **4.3.3 Definition to Definable\_object**

Each Definition refers to a set of one or many Definable\_objects. A set of Definable\_objects defines the defined\_for for Definition.

### **4.3.4 Items to Document\_reference**

Each Item refers to a set of one or many Document\_reference. A set of Document\_reference defines the documentation for Item.

### **4.3.5 Item\_relationship to Item**

Each Item\_relationship refers to two Item. Two Item define item\_one and item\_two for Item\_relationship.

### **4.3.6 Library\_element\_reference to Class\_BSU**

Each Library\_element\_reference refers to exactly one Class\_BSU. A Class\_BSU defines the class\_identifier for Library\_element\_reference.

### **4.3.7 Library\_element\_reference to Library\_property\_and\_property\_value**

Each Library\_element\_reference refers to a set of zero, one or many Library\_property\_and\_property\_value. A set of Library\_property\_and\_property\_value defines the property\_value\_pairs for Library\_element\_reference.

### **4.3.8 Library\_property\_and\_property\_value to Property\_BSU**

Each Library\_property\_and\_property\_value refers to exactly one Property\_BSU. A Property\_BSU defines the property\_identifier for Library\_property\_and\_property\_value.

### **4.3.9 Mechanical\_product\_drawing to Mechanical\_product**

Each Mechanical\_product\_drawing refers to a set of one or many Mechanical\_products. A set of Mechanical\_products defines the defined\_for for Mechanical\_product\_drawing.

#### **4.3.10 Product\_assemblage to Mechanical\_product**

Each Product\_assemblage refers to a set of one or many Mechanical\_products. A set of Mechanical\_products defines the defined\_for for Product\_assemblage.

#### **4.3.11 Product\_composition to Mechanical\_product**

Each Product\_composition refers to a set of one or many Mechanical\_products. A set of Mechanical\_products defines the defined\_for for Product\_composition .

#### **4.3.12 Product\_connectivity to Mechanical\_product**

Each Product\_connectivity refers to a set of one or many Mechanical\_products A set of Mechanical\_products defines the defined\_for for Product\_connectivity.

#### **4.3.13 Product\_participation to Mechanical\_product**

Each Product\_participation refers to a set of one or many Mechanical\_products. A set of Mechanical\_products defines the defined\_for for Product\_participation .

#### **4.3.14 Revision to Definition**

Each Revision refers to a set of one or many Definition. A set of Definitions define the members for Revision.

*The remainder of the application assertions will be defined at a later date.*

## **5 Application interpreted model**

### **5.1 Mapping Table**

This clause contains the mapping table that shows how each UoF and application object of this part of ISO 10303 (see clause 4) maps to one or more AIM constructs (see Annex A).

*To be completed at a later date.*

### **5.2 AIM EXPRESS short listing**

This clause specifies the EXPRESS schema that uses elements from the integrated resources and the AICs and contains types, entity specialisations, rules and functions that are specific to this part of ISO 10303. This clause also specifies modification to the textual material for constructs that are imported from the integrated resources and the AICs. The definitions and EXPRESS provided in the integrated resources for constructs used in the AIM may include select list items and subtypes which are not imported into the AIM. Requirements stated in the integrated resources which refer to such items and subtypes apply exclusively to those items which are imported into the AIM.

*To be completed at a later date.*

## 6 Conformance requirements

Conformance to this part of ISO 10303 includes satisfying the requirements stated in this part, the requirements of the implementation methods supported, and the relevant requirements of the normative references.

An implementation shall support at least one of the following implementation methods:

- ISO 10303-21
- ISO 10303-22.

Requirements with respect to implementation methods are specified in annex C.

The Protocol Information Conformance Statement (PICS) proforma lists the options or the combinations of options that may be included in the implementation. The PICS proforma is provided in annex D.

NOTE 1 ISO 10303-326: - <sup>1)</sup> defines the abstract test suite to be used in the assessment of conformance.

NOTE 2 ISO 10303-32: - <sup>1)</sup> describes the conformance assessment process.

Conformance to a particular class requires that all AIM elements defined as part of that class be supported. Table (*to be specified later*) defines the classes to which each AIM element belongs. The conformance classes are characterised as follows:

This part of ISO 10303 specifies a number of conformance classes that may be supported by an implementation. The conformance classes are:

- Class 1, the shape representation of the mechanical systems and their principal equipment.
- Class 2, the product structure and connectivity information for the mechanical systems and their principal equipment.
- Class 3, the parametric data for mechanical systems and their principal equipment. The data would relate to one or more aspects of mechanical products' lifecycle including product's specification, general characteristics, functional and physical design, operational characteristics, engineering analysis, related tasks, related materials and related anomalies. The definition of data elements are included in ISO 13584 compliant dictionaries for this part of ISO 10303.

Table 1 defines the division of conformance classes and the related units of functionality within a conformance class.

**Table 1 - Conformance Classes**

Unit of functionality	Conformance Class		
	1	2	3
date_and_time	X	X	X
dictionary_items_and_definitions	X	X	X
external_references	X	X	X
items_and_definitions	X	X	X
measure_with_units	X	X	X
mechanical_product_representations	X		
mechanical_product_structures		X	
part41_resources	X	X	X
part42_resources	X	X	X
part_library_references	X	X	X
schedule_and_events	X	X	X
ship_voyages			X
ships	X	X	X

**Annex A**  
(normative)

**AIM EXPRESS expanded listing**

The following EXPRESS is the expanded form of the short form schema given in 5.2. In the event of any discrepancy between the short form and this expanded listing, the expanded listing shall be used.

*To be completed at a later date*

**Annex B**  
(normative)

**AIM short names**

Table B.1 provides the short names of entities specified in the AIM of this part of ISO 10303. Requirements on the use of the short names are found in the implementation methods included in ISO 10303.

**Table B.1 - Short names of entities**

Entity names	Short names

*To be completed at a later date.*



**Annex C**  
(normative)

**Implementation method - specific requirements**

The implementation method defines what types of exchange behaviour are required with respect to this part of ISO 10303. Conformance to this part of ISO 10303 shall be realised in an exchange structure. The file format shall be encoded according to the syntax and EXPRESS language mapping defined in ISO 10303-21 and the AIM defined in annex A of this part of ISO 10303. The header of the exchange structure shall identify the use of this part of ISO 10303 by the schema name 'ship\_mechanical\_systems'.

*To be completed at a later date*

**Annex D**  
(normative)

**Protocol Implementation Conformance Statement (PICS) proforma**

The PICS proforma is supplied for completion by the person or organisation (the client) requesting conformance testing. Its purpose is to ascertain the scope of claimed conformance to a particular application protocol by an implementation under test (IUT) using a defined implementation method. Through the completion of this form, the PICS Proforma becomes a PICS.

The information contained in the PICS is used to configure an appropriate executable test suite for use by the client.

Ten conformance classes are identified in this part of ISO 10303. A conforming implementation shall support at least one conformance class. Each class specifies a subset of ISO 10303-226 AIM constructs. These classes are detailed in clause 6 of ISO 10303-226.

Questions:

1. Please provide an identifier for the product or system for which conformance is claimed:

Product name and current version number: \_\_\_\_\_

2. Please indicate the implementation method chosen:

- ISO 10303-21 Exchange Structure - - preprocessor

Preprocessor name and current version number: \_\_\_\_\_

- ISO 10303-21 Exchange Structure - - postprocessor

Postprocessor name and current version number: \_\_\_\_\_

3. Please indicate the classes for which conformance is claimed:

- Class 1: \_\_\_\_\_

- Class 2: \_\_\_\_\_

- Class 3: \_\_\_\_\_

*To be completed at a later date*

**Annex E**  
(normative)  
**Information object registration**

**E.1 Document identification**

In order to provide for unambiguous identification of an information object in an open system, the object identifier:

{ iso standard 10303 part(226) version(-1) }

is assigned to this part of ISO 10303. The meaning of this value is defined in ISO/IEC 8824-1, and is described in ISO 10303-1.

**E.2 Schema identification**

In order to provide for unambiguous identification of the schema specifications given in this application protocol in an open information system, object identifiers are assigned as follows:

*To be completed at a later date*

**Annex F**  
(informative)  
**Application activity model**

The application activity model (AAM) is provided to aid the understanding of the scope and information requirements defined in this application protocol. The model is presented as a set of definitions of the activities and the data, and a set of activity figures. The viewpoint of the AAM is the users of ship mechanical system's information, including shipbuilder, ship designer, ship operator, equipment supplier and so on.

This AAM identifies the ship life cycle activities across all shipbuilding APs with extensions to ship mechanical systems. As such, the AAM covers activities which go beyond the scope of this part of ISO 10303.

## **F.1 Application activity model definitions**

The following terms are used in the application activity model. Terms marked with an asterisk are outside the scope of this application protocol.

The definitions given in this annex do not supersede the definitions given in the main body of the text.

**F.1.1 acceptable cost level:** the acceptable cost level for maintenance task.

**F.1.2 adjust maintenance program (A4213):** the activity which leads to changes in the maintenance program.

**F.1.3 agree design (A122523, A122543):** the activity which leads to agreement by corresponding organisations on a design.

**F.1.4 agree final design (A25123, A25143):** the activity which leads to agreement by corresponding organisations on a final design.

**F.1.5 agree on auxiliary equipment detail specification (A122531):** the activity which leads to agreement by corresponding organisations on a detailed specification of the auxiliary equipment.

**F.1.6 agree on detail specification of deck machinery (A122552):** the activity which leads to agreement by corresponding organisations on a detailed specification of the deck machinery.

**F.1.7 agree on main engine detail specification (A122512):** the activity which leads to agreement by corresponding organisations on a detailed specification of the main engine.

**F.1.8 alarm:** the signal (e.g. sound or light) automatically generated in case of danger or failure.

**F.1.9 allocate material (A421414, A423114):** the activity which leads to the allocation of material (equipment, raw material etc.) to a maintenance task.

**F.1.10 allocate personnel (A421415, A423116):** the activity which leads to the allocation of personnel to a maintenance task.

**F.1.11 allocate/service tools and equipment (A421416, A423115):** the activity which leads to the allocation of tools and equipment to a maintenance task.

**F.1.12 allocated personnel:** the shipyard personnel, assigned and scheduled to perform a specific maintenance task.

**F.1.13 allowable limits:** the acceptable limits for typical parameters of a specific system, component or part that should be met during maintenance inspection. Otherwise corrective action is required.

**F.1.14 analyse failure (A42122):** the activity of analysing the cause of failures.

**F.1.15 approve auxiliary equipment design (A25132):** the activity which leads to the design approval, by the corresponding organisations, of auxiliary equipment.

**F.1.16 approve/certify maintenance (A42323):** the activity which leads to the approval or certification of a maintenance task.

**F.1.17 approve deck machinery design (A25152):** the activity which leads to the design approval, by the corresponding organisations, of deck machinery.

**F.1.18 approve design of ship machinery (A252):** the activity which leads to the design approval, by the corresponding organisations, of ship machinery. The design approval relates to the machinery equipment and systems. The ship certification is not complete with this activity and would need equipment manufacturing surveys, tests and installation surveys as well.

**F.1.19 approve main engine design (A25112):** the activity which leads to the approval, by corresponding organisations, of the main engine.

**F.1.20 approved design:** the design which complies to the classification society's rules and has been approved by a classification society.

**F.1.21 arrangements\*:** the arrangements of the ship are the ship's compartments and spaces. Any description of arrangements will include associated definitions of purpose for the compartment or space.

**F.1.22 assemble ship (A33):** the activity that assembles the modular units, the serviced parts and additional material that result from the production of steel sub-sections. The result is an assembled ship, that still has to be tested.

**F.1.23 assemble ship/system (A423124):** the activity of assembling a ship or its systems.

**F.1.24 assemble steel sub-sections\* (A331):** the activity of assembling the ship steel sub-sections

**F.1.25 assemble system (A421424):** the activity of assembling the ship systems.

**F.1.26 assembled ship\*:** the ship in its assembled form at the end of the construction phase. The assembled ship has to be tested and commissioned at subsequent activities.

**F.1.27 assembling information:** the data resulting from an assembly activity.

**F.1.28 authorities:** the organisations charged with ensuring the compliance to rules, regulations and standards.

**F.1.29 auxiliary equipment:** an equipment that supports one or more main systems or equipment.

**F.1.30 availability, reliability and maintainability information:** the information about the systems, equipment and components, needed for or resulting from availability, reliability and maintainability analysis.

**F.1.31 available resources:** the tools, test equipment, personnel etc. which a shipyard can allocate for maintenance purposes.

**F.1.32 base material data:** the data relating to spare parts, consumables and raw material which are available in shipyard base depots for maintenance purposes.

**F.1.33 base personnel:** the maintenance personnel at the base harbour.

**F.1.34 base tools and equipment:** tools and equipment available at the base or depot for maintenance purposes.

**F.1.35 basic hull parameters\*:** estimated principal dimensions based on historical data.

**F.1.36 bill of material\*:** the list specifying the parts and their materials which is used for ordering the required parts and material.

**F.1.37 budget\*:** the cost constraint on the design, building and maintenance of the ship.

**F.1.38 building specifications\*:** the information which specifies the detailed framework for the construction of the ship

**F.1.39 calculate cost of ship\* (A124):** this activity describes creation of documents based on technical product data and their estimated manufacturing cost. The results of this activity may contain sale price documents, financing support plan and documents describing funding and possible loans.

**F.1.40 calculate time/cost (A421413, A423113):** the activity by which the duration and cost of a maintenance action are estimated.

**F.1.41 calculated hours, schedule:** calculated required man-hours, machine-hours and schedule needed to perform a specified maintenance action.

**F.1.42 capacity:** the available resources for maintenance purposes such as the number of available personnel.

**F.1.43 carry out manoeuvring system analysis (A122542, A25142):** the activity of completing various engineering analyses on the manoeuvring system as part of design and design approval processes.

**F.1.44 carry out the ship survey (A434):** the execution of a survey on a ship or its equipment.

**F.1.45 carry out transmission system analysis (A122522, A25122):** the activity of completing various engineering analyses on mechanical transmission systems as part of design and design approval processes.

**F.1.46 certificates :** the certificates issued by the classification society and flag state on completing the ship.

**F.1.47 check boilers (A25222):** the activity of checking the boiler specifications against the rules.

**F.1.48 check deck machinery (A25225):** the activity of checking the deck machinery specifications and design against the rules.

**F.1.49 check design against rules and regulations (A2522):** the activity by class society to ensure that equipment and machinery conform to rules and regulations.

**F.1.50 check main engine (A25221):** the activity of checking the specification and design of the main engine against the rules.

**F.1.51 check manoeuvring system (A25223):** the activity of checking the specification and design of the manoeuvring system against the rules.

**F.1.52 check shafting and propeller (A25224):** the activity of checking the specification and design of main shafts and propeller against the rules.

**F.1.53 classification society:** an independent third-party organisation within the marine industry with its own rules and regulations dealing with mainly safety aspects of the ship throughout its lifecycle.

**F.1.54 collect information about local requirements for panels and elements\* (A4323):** the activity which leads to a list of requirements for panels and related elements.

**F.1.55 collect information about safety arrangements\* (A4324):** the activity which leads to the specification of data relating to safety arrangements.

**F.1.56 collect information about systems and components (A4322):** the activity which leads to the specification of information relating to systems and components of a system.

**F.1.57 collect owner's information on usage of tank\* (A4326):** the activity which leads to information relating to tank usage.

**F.1.58 collect relevant data (A42121):** the activity which leads to the collection of relevant data needed for diagnosis.

**F.1.59 collect survey information about tank to be inspected\* (A4321):** the activity which leads to the specification of tank data required prior to tank inspection.

**F.1.60 company objectives:** the business objectives of a company relating to the use of maintenance data/information for future purposes.

**F.1.61 compare values (A42112):** the activity of comparing two values for fault diagnosis purposes.

**F.1.62 complete and approve ship design (A2):** the production of ship design documents and the classification drawings using the preliminary design from the bid preparation, as well as the required rules and regulations. The classification drawing may require several iterations with input and redmarking from the classification society.

**F.1.63 complete design of outfitting and distribution systems\* (A26):** the selection of the necessary outfitting equipment. The selection is mainly based on former designs and in accordance with the requirements. It also contains the layout of the different types of distribution systems.

**F.1.64 complete design of ship machinery (A25):** the selection and arrangement of the ship equipment in terms of the main engine, associated propulsion system and its auxiliary machinery.

**F.1.65 complete design of ship structure\* (A24):** the completion of the ship structural design.

**F.1.66 components:** the equipment or components which are part of the ship systems.

**F.1.67 conclude (A42123):** the activity of concluding a diagnostic investigation.

**F.1.68 condition of class\*:** the maintenance condition of a ship from the classification society point of view. An unsatisfactory condition means that the ship no longer fulfils the classification requirements and maintenance deemed to be necessary.

**F.1.69 conduct acceptance trials\* (A344):** the activity of sea trials that are performed with the owners and classification society to test the ship against the rules and regulations and the design. The output is the test result documentation.

**F.1.70 conduct contractor sea trials\* (A343):** the activity of sea trials performed by the contractor to test the ship against rules and regulations and the design. The output is the test result documentation.

**F.1.71 contract:** the contract is the output from the activity which involves placing the order for the ship. The contract is used as a constraint in subsequent activities such as final design, approval and production.

**F.1.72 corrective actions:** the specification of activities needed to correct the status of a product.

**F.1.73 corrective maintenance plan:** the maintenance plan which specifies the corrective actions needed in order to maintain a failing system to its original specifications, fit for release for operation.

**F.1.74 cost \*:** the calculated cost of the ship based on the cost of material and labour.

**F.1.75 cost calculation data\*:** the information needed for performing a maintenance task cost analysis.

**F.1.76 create preliminary blades (A1223133):** the activity which leads to preliminary definition of propeller blades including blade overall size and geometric configuration.

**F.1.77 create preliminary design (A122):** all design activities relevant in a very preliminary stage of ship design in consideration of classification rules, national/international demands, shipyard constraints and owner requirements. The aim of this task is to make a shipyard offer.

**F.1.78 create preliminary general arrangements\* (A1222):** the activity that produces the preliminary compartmentation plans from the preliminary hull form definition.

**F.1.79 create preliminary hull form\* (A1221):** the activity that is the first step in designing a ship. Using parent ship's main dimensions and form parameters, one or more preliminary hull forms will be generated.

**F.1.80 create preliminary machinery design (A1225):** the activity that produces the preliminary designs for the ship machinery; including the prime mover, shaft system, fuel system, power systems and cargo handling equipment and so on.

**F.1.81 create preliminary outfitting design\* (A1226):** the activity that produces the preliminary design for ship's outfitting including distributed systems such as piping and electrical systems.

**F.1.82 create preliminary propeller arrangements (A1223132):** the activity which leads to the definition of the preliminary propeller arrangements in relation to hull.

**F.1.83 create preliminary propeller components (A1223134):** the activity of deciding on the preliminary structure of a propeller in terms of its major components.

**F.1.84 create preliminary structure design\* (A1224):** the activity that produces the preliminary steel structure design, including the arrangement of the primary structural members.



**F.1.85 crew:** the personnel onboard a ship.

**F.1.86 crew staff:** the ship crew members in charge of controlling and co-ordinating of shipboard activities (usually captain and officers).

**F.1.87 critical design areas:** the design areas at which a change may be expected, when performing a design approval preview

**F.1.88 data from other sources:** the data needed for performing the failure analysis which are not available from the normal on-board data sources such as logbook and maintenance manual.

**F.1.89 decide post sales maintenance and support (A123):** the activity that puts together the maintenance package for the ship. This is part of the tender document and includes the post sales support.

**F.1.90 deck machinery:** the machinery positioned on the main deck of the ship.

**F.1.91 decommission and disassembly (A5):** the activities that involve disassembly and preparing for reuse or recycling or disposal of machinery, parts, materials and so on.

**F.1.92 define corrective actions (A42131):** the activity which uses the diagnosis report and provides a list of actions needed to be undertaken as corrective maintenance.

**F.1.93 define cost\* (A42134):** the activity which leads to the estimation of maintenance cost.

**F.1.94 define resources (A42132):** the activity which leads to a list of required resources needed for maintenance.

**F.1.95 define time (A42133):** the activity which leads to specification of time needed for maintenance.

**F.1.96 deliver auxiliary equipment (A3333):** the activity which leads to the delivery of the ship equipment to the shipyard.

**F.1.97 deliver machinery (A3331):** the activity which leads to the delivery of the ship machinery to the shipyard

**F.1.98 delivery date:** the date for delivery.

**F.1.99 description of function:** the description of the function that the component to be analysed shall perform.

**F.1.100 design manoeuvring systems (A12254):** the activities which lead to design of the manoeuvring system by the shipyard for the ship.

**F.1.101 design modifications:** the list of modifications made to the original design.

**F.1.102 design transmission system (A12252):** the activities which leads to design of the ship main mechanical transmission system.

**F.1.103 detail survey planning (A4325):** the activity which leads to a detailed plan for survey.

**F.1.104 detailed instructions:** the detailed procedure, resources needed and method of carrying out a maintenance activity.

**F.1.105 detailed schedule:** the detailed timetable for execution of maintenance actions together with a schedule of availability of tools and other resources.

**F.1.106 detailed specification:** the ship equipment and systems specifications as required for approval by the ship owner.

**F.1.107 diagnose (A4212):** the activity which leads to diagnosis of the reason for a failure.

**F.1.108 diagnosis report:** a document describing the conclusion of a failure analysis. It is the basis for preparation of a corrective maintenance plan.

**F.1.109 disassemble ship/system (A423121):** the process of disassembling of a ship or its systems.

**F.1.110 disassemble system (A421421):** the activity of disassembling a ship system.

**F.1.111 distribution & outfitting design\* :** the design of the distribution systems (electrical and piping) and the outfitting.

**F.1.112 equipment:** a part of the engineering systems that carries out a generally self contained function and to a large extent can be treated as a single item for the purpose of design, acquisition or operation.

**F.1.113 estimate hydrodynamics and powering (A1223):** the activity that approximates hydrodynamic properties data calculations like resistance, propulsion, seakeeping and manoeuvrability for the preliminary hull form.

**F.1.114 estimate hydrodynamics and powering\* (A1223135):** the activity which leads to hydrodynamic resistances of a ship and the power needed for ship propulsion.

**F.1.115 estimate manoeuvrability\* (A12233):** the activity that deals with approximating the manoeuvrability of the ship and comparison of the results with design requirements. The proof of the ships manoeuvrability will principally be given in practice or by model testing. Measuring of rudder forces and rudder moments as well as of the radius of the turning circle during model tests will be done either in circulating water channels or manoeuvring basins.

**F.1.116 estimate resistance and powering (A12231):** the activity that includes the calculations based on historical data for producing powering and resistance data for the initial preliminary design.

**F.1.117 estimate sea keeping\* (A12232):** the activity that calculates the theoretical behaviour of a vessel in a seaway. The solution of the coefficients of equations of motion may be obtained either by analytical or numerical methods. The natural periods of the ship will be calculated like the rolling, pitching and heaving motions.

**F.1.118 evaluate maintenance (A4233):** the activity which leads to evaluation of the whole of the maintenance activity on behalf of either shipyard or owner.

**F.1.119 evaluate request & schedule bid\* (A121):** the activities of the shipyard when evaluating the inquiry of the ship owner for a new ship.

**F.1.120 evaluation report:** a document which contains the results of the maintenance evaluation activity and normally references the status, diagnosis, corrective action and maintenance reports.

**F.1.121 execute maintenance (A42142, A42312):** the activity which leads to execution and completion of a maintenance task.

**F.1.122 experience\*:** applied expert knowledge.

**F.1.123 failure analysis report:** a document which describes the scope, analysis methodology and result of a failure analysis activity.

**F.1.124 feedback:** the feedback information.

**F.1.125 finalise and approve general arrangements\* (A21):** the activity in which the design of a ship general arrangement is finalised as a detailed design.

**F.1.126 finalise and approve hull form\* (A22):** the activity in which the hull form is finalised from the preliminary design done in the pre-contract stages. The result is a final and approved hull form design.

**F.1.127 finalise and approve hydrodynamics and powering\* (A23):** this includes all relevant hydrodynamic calculations like resistance, propulsion, seakeeping and manoeuvrability.

**F.1.128 finalise auxiliary equipment selection (A2513):** the activity which leads to the selection and ordering of auxiliary equipment.

**F.1.129 finalise deck machinery design (A2515):** the activity which lead to the production of final design for deck machinery.

**F.1.130 finalise machinery design (A251):** the activities which leads to design of selected machinery such as the propeller which are in the scope of this part of ISO 10303.

**F.1.131 finalise main engine selection (A2511):** the activity which leads to the selection and ordering of the main engine.

**F.1.132 finalise maintenance plan (A254):** the activity which leads to preparation of a machinery maintenance plan.

**F.1.133 finalise manoeuvring system design (A2514):** the activity which leads to the design of the manoeuvring system.

**F.1.134 finalise production planning\* (A253):** the activities which lead to a production plan.

**F.1.135 finalise propeller design (A25122):** the activity which leads to the final propeller design.

**F.1.136 finalise selection of components (A25121, A25141):** the activity which leads to the selection of various ship equipment.

**F.1.137 finalise transmission system design (A2512):** the activity which leads to the completion of the ship main mechanical transmission system design.

**F.1.138 general arrangements\*:** the space arrangement plan from the preliminary or final design stage.

**F.1.139 geometry, geography, technical documentation\*:** all documents, describing the ship, its systems and equipment.

**F.1.140 historical data from previous designs:** data held by the shipyard or model basin on previous ship designs and used to estimate the hydrodynamics, powering requirements and sea-keeping.

**F.1.141 hull form sections\*:** The design of the hull moulded form at planar sections taken along the longitudinal axis of the ship.

**F.1.142 hull moulded form\*:** the definition of the shape of the hull of the ship, resulting from the addition of the aft-body, mid-body and fore-body definitions, which does not take into account the thickness of the material from which the hull is made.

**F.1.143 hydrodynamics & powering results\* :** the results of calculations and model basin tests. They contain resistance, propulsion, propeller performance, brake power, service speed, sea keeping and manoeuvrability data.

**F.1.144 hydrostatic table\*:** the data which show the hydrostatic properties of the ship. They are a result of calculations at the initial and final design stages.

**F.1.145 info parts to be repaired:** the specific available information on the repair of parts, to be dispatched with parts for repair purposes.

**F.1.146 info parts to be replaced:** the specific information relating to replacement of parts.

**F.1.147 info parts to be serviced:** the specific information on the servicing of parts after disassembly of the ship/system.

**F.1.148 information sub-assemblies:** the information on steel sub-assemblies.

**F.1.149 inspection information:** the information resulting from previous inspection which may be used for maintenance and repair purposes.

**F.1.150 inspect ship/system (A42322):** the activity which leads to the inspection of a ship and its equipment.

**F.1.151 install auxiliary equipment (A3334):** the activity which leads to the installation of the auxiliary equipment.

**F.1.152 install equipment (A333):** the activity which leads to the installation of the equipment.

**F.1.153 install machinery (A3332):** the activity which leads to the installation of the machinery.

**F.1.154 install modular build units\* (A332):** the activity which leads to the installation of modular build units.

**F.1.155 install modular machinery systems\* (A334):** the activity which leads to the installation of modular machinery systems.

**F.1.156 installed equipment:** the ship equipment as-installed information.

**F.1.157 integrate changes on auxiliary equipment design (A25131):** the process of including design refinements in the auxiliary equipment design in order to generate the final design.

**F.1.158 integrate changes on deck machinery design (A25151):** the process of including design refinements in the deck machinery design in order to generate the final design.

**F.1.159 integrate changes on main engine design (A25111):** the process of including design refinements in the main engine design in order to generate the final design.

**F.1.160 knowledge and experience:** the previous experience and knowledge of companies involved throughout the ship lifecycle.

**F.1.161 laws, rules and regulations :** national laws, statutory regulations and classification society rules that are used to control the design, manufacture, operation, maintenance and scrapping of the ship.

**F.1.162 list of items to be inspected:** the list of ship items, provided by the classification society or any other authorities to the owner, which needs to be inspected.

**F.1.163 list of required certificates\*:** as a result of placing an order, this is the list supplied by the ship owner for certificate requirements.

**F.1.164 list of required personnel:** the list of technical personnel, for carrying out the specific task, including numbers, training and skill (experience) information.

**F.1.165 list of required resources:** the list of required resources including required tools, equipment, material and personnel for completion of a task.

**F.1.166 list of tools and equipment:** the list of tools and equipment needed to carry out a task.

**F.1.167 loading and stability manual\*:** the document which details loading and stability information for use by the ship operator.

**F.1.168 loading conditions\*:** standard loading conditions, defining the quantities of cargo, ballast water and consumables such as fuel oil and lubrication oil, in each space or compartment, which is used as a basis for design.

**F.1.169 logbook:** the shipboard documentation, recording the main aspects of ship and equipment's operation characteristics, events etc. The logbook is updated daily.

**F.1.170 machinery design:** the design drawings and electronic models of the ship mechanical systems. An output from the final design process.

**F.1.171 machinery systems:** an engineering system comprising of reciprocating or rotating equipment with the primary function of providing mechanical power against a load.

**F.1.172 main engine:** the information required in order to select the main engine.

**F.1.173 maintain a ship (A42):** the activity of bringing up a ship to its acceptable sailing condition, normally after a failure or a predefined period of operation.

**F.1.174 maintain at base (A422):** the execution of the maintenance task at base (port).

**F.1.175 maintain at yard (A423):** the execution of the maintenance task at shipyard.

**F.1.176 maintain on board (A421):** the execution of the maintenance task on-board ship at sea.

**F.1.177 maintenance history:** the documented history of maintenance information, normally beginning with the commissioning phase of ship lifecycle.

**F.1.178 maintenance personnel:** the personnel or crew needed to perform the maintenance activity.

**F.1.179 maintenance reports:** documents (reports) which describe all aspects of a specific completed maintenance task including procedures used, equipment or system information, actions carried out and results.

**F.1.180 make report (A421426, A423126):** the activity which leads to the preparation of the task report.

**F.1.181 manoeuvring system:** a system used to perform planned movement or change from the straight steady course and speed of a ship.

**F.1.182 manoeuvring system design:** the design specification and drawings of the ship manoeuvring system.

**F.1.183 manufacturing restrictions :** a constraint on the ship construction and design processes governed by available technology and shipyard facilities.

**F.1.184 material allocation/ordering\*:** the data describing the necessary material supply for production.

**F.1.185 material and certificates\*:** the name and specification of materials and the required quality and quantity certificates.

**F.1.186 material data\*:** the specification of material properties.

**F.1.187 material list\*:** the list of raw materials needed to manufacture the ship. A result of the final design process.

**F.1.188 measurement report:** the document (report) containing the measured values of a parameter from an instrument, related to condition (status) of systems.

**F.1.189 model basin consultants\*:** the organisations which perform model basin tests to calculate hydrodynamics and powering data.

**F.1.190 model basin theory\*:** the theory, along with empirical data, used by the model basin consultants to calculate the hydrodynamics and powering information.

**F.1.191 modifications from machinery:** modifications due to changes to machinery.

**F.1.192 modification to hull form\*:** modifications to the hull shape due to feedback from hydrodynamics and powering results and the final design process.

**F.1.193 modular build units\*:** the modular assemblies of ship steel sub-sections, normally produced in the shipyard. These are later on assembled onto the ship.

**F.1.194 modular machinery systems\*:** the modular assemblies of ship machinery systems, either assembled in or delivered to the shipyard. These are later on assembled onto the ship.

**F.1.195 monitor status (A4211):** the process of monitoring the status of equipment.

**F.1.196 noise and vibration level:** the equipment and system noise and vibration levels that influence the design of ship systems.

**F.1.197 notify owner about items due to survey (A431):** the activity by which the ship owner is informed of the items which need to be surveyed by the class society.

**F.1.198 observe signal (A42111):** the activity or process by which a specific signal or parameter is being monitored.

**F.1.199 offer\*:** the result of the preliminary design process. It will contain the shipyard's data for producing the requested ship.

**F.1.200 offer guidelines\*:** the offer guidelines include the data necessary to make an unconditional offer to the ship owner.

**F.1.201 on-board material data:** the data relating to spare parts and consumables for on-board maintenance.

**F.1.202 on-board tools and equipment:** the tools and testing equipment, on-board-ship, needed for maintenance.

**F.1.203 operate and maintain a ship (A4):** the activity that describes the running and maintenance of the ship during its service lifetime.

**F.1.204 operate a ship (A41):** the activity of keeping a ship in operation.

**F.1.205 operational history:** the operational historical data, normally recorded in the ship logbook.

**F.1.206 operational information:** accumulated information during the operation phase of the ship used for maintenance and in the final scrapping stage.

**F.1.207 operation manual:** the document (manual) describing how an equipment or system should be operated.

**F.1.208 owner :** the organisation which requests, orders and takes delivery of the ship.

**F.1.209 owner request, requirements :** the requirements document that is submitted to the shipyard by the owner upon the invitation to tender.

**F.1.210 perform design approval (A2521):** the activity which is mainly carried out by the classification society in approving the design of certain equipment and systems.

**F.1.211 perform maintenance (A4214, A4231):** the activity of carrying out a maintenance task.

**F.1.212 perform ship lifecycle (A0):** all of the lifecycle activities associated with a ship.

**F.1.213 place order\* (A13):** the owner places an order for a ship from the bids that have been submitted. From this a contract is awarded.

**F.1.214 planned maintenance system:** a software system relying on the data created during the final design process and used during the operation and maintenance of the ship.

**F.1.215 power requirements for engine:** the engine power resulting from the hydrodynamics and powering calculations which is used in the selection of the main engine.

**F.1.216 pre-layout\*:** the very initial layout of the ship which is produced during the bid evaluation stage and is the basis for the preliminary design.

**F.1.217 predict brake power and service speed\* (A122314):** the activity that estimates the required propulsive power and speed in order to be able to choose the correct size of main engine and propeller.

**F.1.218 predict propeller performance (A122313):** the activity that uses propulsion data to produce an initial propeller functional design.

**F.1.219 predict propulsion data\* (A122312):** an activity that estimates propulsion data including propulsive power and other data, such as propulsive coefficient, propeller coefficient, hull efficiency, relative rotative efficiency, thrust deduction fraction and wake fraction.

**F.1.220 predict resistance\* (A122311):** the activity that predicts the ship resistance. The resistance calculation will be done using historical data related to the geometry of the ship.

**F.1.221 preliminary design :** the preliminary ship design, which is completed in the phases leading up to the submittance of the tender.

**F.1.222 preliminary hull form\*:** the definition of the hull form, as a result of the preliminary design process. Used in the offer documents and for preliminary hydrodynamics and powering calculations.

**F.1.223 preliminary machinery design:** the overall specifications of the ship mechanical systems, resulting from the preliminary design process. Used in the offer document and for preliminary compartment design, hydrodynamics and powering calculations.

**F.1.224 preparation report:** a document.

**F.1.225 prepare bid (A12):** all activities of the shipyard regarding preparation and submission of the offer to the ship owner for the ship to be built.

**F.1.226 prepare for maintenance at base/yard (A4215):** all activities relating to the preparation of the ship or its equipment/systems for a maintenance task to be carried out at the base harbour/shipyard.

**F.1.227 prepare maintenance (A42141, A42311):** all activities relating to the preparation of the ship or its equipment/systems for a maintenance task.

**F.1.228 prepare ship for survey (A433):** all activities relating to the preparation of a ship or its equipment/systems for survey.

**F.1.229 present offer\* (A125):** the activity concerned with presentation of the offer to the ship owner for building a new ship.

**F.1.230 preventive maintenance procedures:** the document describing the procedures for preventive maintenance.

**F.1.231 previous design\*:** an existing ship design, that is used as the basis for a new ship design.

**F.1.232 produce and approve reference documents\* (A35):** the activity of creating the technical documentation for the ship, using production information. The output includes the loading and stability manual.

**F.1.233 produce and inspect ship (A3):** the activity that describes how the design is transformed into a real product. In the production phase the design has to prove its produceability. The production is controlled by the schedule, the approved design, the contract and any manufacturing restrictions. The result of the activity is the completed ship and technical documentation and certificates.

**F.1.234 produce modular build units\* (A32):** the activity which leads to the production of the modular units which will make up the completed ship. They are produced from the steel sub-sections and their production is controlled by the schedule, contract, the approved design, and any



manufacturing restrictions. The results of the activity are the modular units which are assembled into the ship.

**F.1.235 produce steel sub-sections\* (A31):** the activity which leads to the production of the steel sub-sections which make up the structure of the completed ship. This is controlled by the schedule, contract, the approved design, and any manufacturing restrictions.

**F.1.236 product component information:** the technical data of the components that will be incorporated into the ship. These are taken into consideration when the preliminary designs are being made.

**F.1.237 production information\*:** information describing a product, e.g. dimensions, mechanical properties, workshop information.

**F.1.238 product model data:** information describing a product. In this case, all the information about the ship over its lifecycle belongs to the product model data.

**F.1.239 propeller design:** the design of the propeller or propulsor as a result of the hydrodynamics and powering calculations. The design controls some of the machinery design activity.

**F.1.240 propeller functional design:** the functional design data of the propeller.

**F.1.241 propeller theory:** the body of knowledge based on the historical experience and abstract ideas of ship propeller performance.

**F.1.242 proposed designs\*:** the output from the preliminary design stage that includes the best short list of ship designs that satisfies the proposed owner's requirements.

**F.1.243 qualification requirements:** the required qualification of the personnel to be allocated to a task

**F.1.244 quality assurance\*:** an organisation within the shipyard that has the task to audit the shipyard organisation and applied processes in a manner such that the quality of the resulting product is assured.

**F.1.245 refined design for classification:** the new design which would require the approval of the classification society.

**F.1.246 regular wave theory \*:** the body of knowledge which relates the motion response of a ship in waves of constant height and period.

**F.1.247 release for operation (A4232):** the process of releasing a ship for operation.

**F.1.248 relevant data:** the data needed for carrying out a specific task.

**F.1.249 repair information:** the information about the repair task including procedures, resource data and organisation responsible.

**F.1.250 repair parts (A421423, A423123):** the activity which leads to the maintenance of parts.

**F.1.251 request a ship\* (A11):** the first activities of a ship owner when intending to order a ship. Having definite ideas regarding appearance and functionality of the ship, the owner expresses these ideas in an inquiry to the shipyard.

**F.1.252 request for additional data:** a request for extra information to enable the completion of a task.

**F.1.253 request for changes\*:** changes that are requested to the ship design as a result of production experience or difficulties with the realisation of the ship design.

**F.1.254 request for other level maintenance:** the request for maintenance on another level as a result of a diagnosis activity.

**F.1.255 request to change corrective actions:** the request for changing the corrective actions for reasons that there are strong concerns about the feasibility of the planned actions.

**F.1.256 request to change corrective maintenance plan:** the request for changing the corrective maintenance plan for stated reasons.

**F.1.257 request to change working plan:** the request for changing the applicable working plan for reasons stated in the request.

**F.1.258 resistance and powering results:** the results for the resistance and powering of the ship determined from model tests.

**F.1.259 resistance and shaft power:** the ship resistance and required propulsive power.

**F.1.260 resistance theory\*:** the theory used to predict the resistance of the hull to forward motion in the sea.

**F.1.261 resource allocation\*:** the result of the capacity planning.

**F.1.262 resources:** shipyard, classification society and consultants.

**F.1.263 results of zigzag, initial turning etc.\* :** the manoeuvring test results as from model basin tests or sea trials.

**F.1.264 review maintenance report (A42321):** the activity which analyses the maintenance report.

**F.1.265 reviewed maintenance report:** the document (maintenance report) which has undergone full review.

**F.1.266 scantling requirements for plates stiffeners and other strength elements for all the panels, surrounding this tank\*:** the dimension of stiffeners and other strength elements.

**F.1.267 schedule:** the time table for a task.

**F.1.268 schedule (A421411, A423111):** the preparation of the time table for a task.

**F.1.269 scrapping plan:** the document which provides the schedule and resources required to dismantle the ship.

**F.1.270 select auxiliary equipment (A12253):** the activities which lead to the selection of auxiliary equipment.

**F.1.271 select components (A122521, A122541):** the activity which leads to the selection of ship equipment.

**F.1.272 select deck machinery (A12255):** the activity which leads to the selection of deck machinery.

**F.1.273 select main engine (A12251):** the activities which lead to the selection of the main engine by the shipyard.

**F.1.274 service information:** the information/data about the service activities.

**F.1.275 service load required draughts etc.\*:** information about the service activities of the ship.

**F.1.276 service parts (A421422, A423122):** the activity of testing, upgrading and changing parts within a survey or maintenance activity.

**F.1.277 ship :** a large waterborne vessel whose design, manufacture and lifecycle operation is governed by the principles of naval architecture and in accordance with international and classification society regulations.

**F.1.278 ship product data:** the data describing the ship as a product.

**F.1.279 ship weight modifications\*:** modification to ship weight due to the preliminary structure design.

**F.1.280 shipyard:** an organisation that designs and builds, maintains or repairs ships.

**F.1.281 shipyard and classification society:** the shipyard and classification society organisations.

**F.1.282 shipyard and consultants:** the resources of the shipyard which builds the ship and consultants who provide assistance in design.

**F.1.283 shipyard (experts and tools):** the shipyard's experts and software tools are the means by which the ship design is carried out.

**F.1.284 short and long term responses\* :** the results of estimation of sea keeping ability that take into account both short term journeys in local seas and long term world wide journeys.

**F.1.285 signal:** any indicative thing such as measured values by meters, a visual impression etc.

**F.1.286 specify and select auxiliary equipment (A122532):** all activities associated with defining the specification of auxiliary equipment and its selection.

**F.1.287 specify and select deck machinery (A122551):** all activities associated with defining the specification of deck machinery and its selection.

**F.1.288 specify and select main engine (A122511):** all activities associated with defining the specification of the main engine and its selection.

**F.1.289 specify initial propeller characteristics (A1223131):** the activity which leads to the definition of overall propeller characteristics.

**F.1.290 specify ship (A1) :** all activities associated with the production of a detailed specification of the ship prior to a contract being placed.

**F.1.291 speed :** the design speed of the ship, as specified by the owner in the contract.

**F.1.292 status report:** a document (report) detailing the status of an equipment or system. The status report results from condition monitoring.

**F.1.293 steel sub-sections:** the sub-sections of the steel structure which are outfitted with the machinery and distribution systems before assembly.

**F.1.294 structural design\* :** the design of the hull structure including hull, bulkheads, decks and stiffeners.

**F.1.295 structure\*:** the steel structure of the ship including hull, bulkheads, decks and stiffeners.

**F.1.296 sub-sections\*:** the steel sub-sections of a ship structure.

**F.1.297 suppliers:** the organisations which supply equipment to shipyard and ship owner.

**F.1.298 support :** all the organisations and personnel who contribute to the lifecycle of the ship.

**F.1.299 survey a ship (A43):** the activity which leads to the survey of a ship or its equipment.

**F.1.300 survey plan:** a document outlining the details of a survey plan with information such as critical areas, corrosion, risk schema, name of components/systems to be inspected.

**F.1.301 survey planning (A432):** the activity which leads to preparation of a survey plan.

**F.1.302 survey report:** the document (report) stating the results and details of a survey activity.

**F.1.303 survey status:** the data specifying the current status of a ship with regard to survey.

**F.1.304 tank usage documentation:** a document specifying the usage of a tank.

**F.1.305 technical documentation:** the documents which provide technical description for performing preventive maintenance.

**F.1.306 technical documentation inspection report:** a document.

**F.1.307 technical requirements\* :** the detailed ship specification issued by the owner on the award of a contract to build a ship.

**F.1.308 test (A421425, A423125):** the activity of testing a part, a component, equipment or a system to its performance according to the specification.

**F.1.309 test results:** the maintenance test results are the results of functional tests carried out after the execution of maintenance tasks.

**F.1.310 test ship (A34):** this activity tests the actual ship against the design, contract and rules and regulations. The structure is tested and sea trials including testing of machinery are carried out. The test results are an output from this activity.

**F.1.311 test structures\* (A341):** the steel structures are tested against rules and regulations and the design. The output is the test result documentation.

**F.1.312 test systems (A342):** the ship's systems including outfitting, machinery and mission systems are tested against rules and regulations and the design. The output is the test result documentation.

**F.1.313 time/cost criteria:** the shipyard criteria for calculating cost and time of a task (e.g. maintenance).

**F.1.314 time/cost overview:** estimated cost/time needed for carrying out a task.

**F.1.315 tools and equipment ready for use:** the details of available tools and equipment for maintenance.

**F.1.316 tools and equipment requirements:** the details of required tools and equipment for maintenance.

**F.1.317 total resistance\*:** the resistance of the hull due to motion in the water.

**F.1.318 transmission system:** a system by which motive power from a prime mover is made available at load and matched to load (e.g. shafting system connecting main engine to propeller, or shafting system connecting auxiliary engine to generator).

**F.1.319 transmission system design:** the definition of the transmission system design. Includes all the information, normally in drawing form, including those of the selected equipment.

**F.1.320 transportation needs:** a constraint which determines the specification for ship constructions.

**F.1.321 update logbook (A42324):** the activity of recording new operational data in the ship logbook.

**F.1.322 update maintenance history (A42325):** the activity of recording new maintenance data in the ship maintenance history document.

**F.1.323 updated logbook:** the logbook resulting from the inclusion of new operational data.

**F.1.324 updated maintenance history:** the maintenance history document resulting from inclusion of new maintenance data.

**F.1.325 updated survey status:** the status report resulting from inclusion of new survey data.

**F.1.326 validate initial propeller (A1223136):** the activity of validating the initial propeller design for satisfying the hydrodynamic and powering requirements of the ship.

**F.1.327 weights and compartmentation\*:** the ship arrangement and weight details.

**F.1.328 weights distribution\*:** the details of the weight distribution taking account of steel weight, machinery weights and cargo and the associated floating position of the ship.

**F.1.329 work calculation data\*:** the data such as labour rates, depreciation rates, operating costs etc. needed for calculation of financial estimates.

**F.1.330 work load\*:** the total effort required to build the chosen ship design as estimated by the shipyard and its consultants.

**F.1.331 write/select instructions (A421412, A423112):** the process of selecting the instructions needed for carrying out a task.

**F.1.332 yard:** an organisation that designs and builds, maintains or repairs ships.

**F.1.333 yard facilities:** all the equipment, tools, infrastructure, personnel etc. of a shipyard used for ship production.

**F.1.334 yard material data\*:** the data relating to available, equipment, tools, components, parts and raw material in a shipyard.

**F.1.335 yard personnel\*:** the technical personnel of a shipyard.

**F.1.336 yard staff\*:** the staff of a shipyard.

**F.1.337 yard tools and equipment\*:** the tools and equipment of a shipyard.

## **F.2 Application activity model diagrams**

The application activity diagrams are given in Figures F.1 to F.44. The graphical form of the application activity model is presented in the IDEF0 activity modelling format. Activities and data flows that are out of the scope of this part of ISO 10303 are marked with asterisks.

*Figure F.1 to F.44 are exactly as those in previous working draft (N793) and will be added at a later date.*

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**Annex H**  
(informative)  
**AIM EXPRESS-G**

*To be completed at a later date.*



**Annex J**  
(informative)  
**AIM EXPRESS listing**

*To be completed at a later date.*

**Annex K**  
(informative)  
**Bibliography**

*National Institute of Standards and Technology; Integration Definition for Functional Modelling (IDEFO) 21st December 1993, National Institute of Standards and Technology Draft Federal Processing Standards Publication 183.*

ISO 10303-221<sup>1</sup>, *Industrial automation systems and integration — Product data representation and exchange — Part 221: Functional data and their schematic representation for process ship.*

ISO 10303-227:1995(E), *Industrial automation systems and integration - Product data representation and exchange - Part 227: Application Protocol: Ship Spatial Configuration.*

ISO 13584-10, *Conceptual description: Conceptual Model of Parts Library.*

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<sup>1</sup> To be published

**Annex L**  
(informative)  
**Technical discussion**

## **L.1 Introduction**

This annex has been prepared in order to provide the general and introductory information on technical methodology adopted within this part of ISO 10303. This annex describes the following:

1. An introduction to STEP and ship product related Application Protocols with special reference to Part 226 on Ship Mechanical Systems.
2. Concepts common to all ship product Application Protocols, including type hierarchies related to concept of item, definitions and association of definitions to item.
3. Architecture of AP226 data model including the AP226 data planning model and description of how the full scope of AP226 is embodied in the data model.

The expected audience of this annex are those who intend to either review this part of ISO 10303 or subsequently use and implement this standard.

## **L.2 STEP and Ship Application Protocols**

### **L.2.1 What is Step?**

The STEP initiative was officially begun in 1984 as a means of facilitating concurrent engineering within the manufacturing industry. STEP is the widely used name for **ISO 10303 - Product Data Representation and Exchange** and is being developed under the guidance of the ISO Technical Sub-Committee **TC184/SC4**.

The aim of STEP, the STandard for the Exchange of Product model data, is the complete and unambiguous representation of a product such as a ship, a car, or an airplane, throughout its lifetime, in a computer interpretable neutral format. As such, the STEP initiative is directed towards enabling a product to be consistently represented from the requirement definition stage of its life, through the conceptual design, production and through-life operation and maintenance stages and then finally into the decommissioning phases. The ability to define data will enable organizations to reuse, exchange and share data to mutual advantage. With so much variety, it would be easy for STEP to be too complex to be useful. To avoid this, the STEP standard has user specific parts, each of which describes:

- The standard data definitions for that particular application area.
- How that data will be exchanged or shared

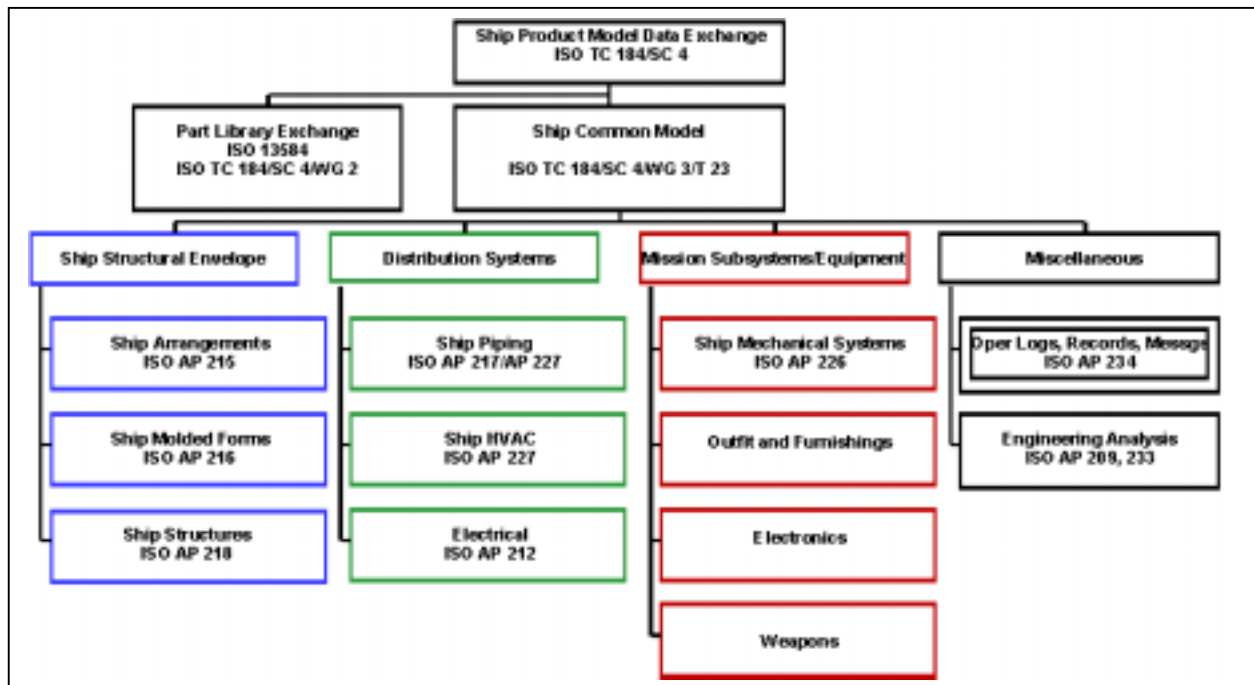
These parts are known as **Application Protocols (AP)**.

### **L.2.2 The STEP Ship Model**

The STEP ship model is a subset of the wider ISO STEP initiative. It currently comprises five application protocols which are under development. These are:

AP215	Ship Arrangements	AP218	Ship Structures
AP216	Ship Moulded Forms	<a href="#">AP226</a>	<a href="#">Ship Mechanical Systems</a>
AP217	Ship Piping Systems	AP234	Ship Logs and Records

The above series of ship product application protocols assumes that the ship as a product can be divided into separate ship systems such that each covers a key element of the ship for its entire life cycle. These key systems are: ship moulded forms, ship arrangements, ship distribution systems (piping, heating, ventilation and air conditioning, and electrical/cableway), ship structure, ship mechanical systems, ship outfit and furnishing, and ship mission systems (see Figure L.1).

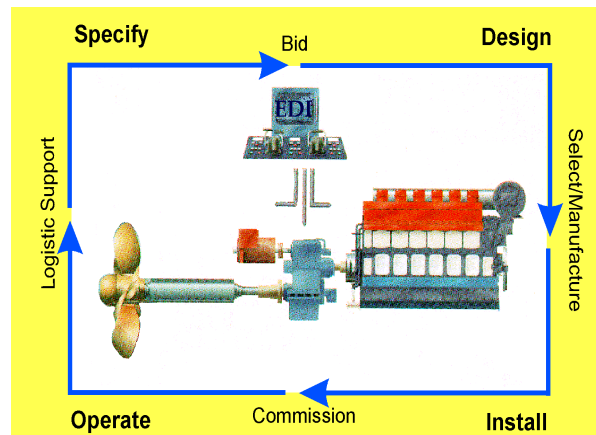


**Figure L.1 - Ship product application protocols**

Each separate system is described by one or more different application protocols. The development of these application protocols involves input from organisations from all aspects of the shipping community world-wide: shipbuilders, marine engineering component suppliers, shipowners, classification societies and so on.

### L.2.3 AP226: Ship Mechanical Systems

The scope of the AP226 encompasses the following physical systems: propulsion systems, auxiliary systems and deck machinery including all of their major equipment. Each of these systems are currently broken down into sub-groupings in order to facilitate information capture for various components within the decomposition hierarchical structure. These are documented in Annex M of this Part of ISO 10303. AP226 will provide a life cycle view of the above systems covering information requirement from concept through design/selection, operation, monitoring, inspection to decommissioning (see Figure L.2). This life cycle view will provide a powerful infrastructure for developing data storage, data handling and application modules for concurrent engineering in shipbuilding and for ship-board systems and ship to shore data communication in shipping.



**Figure L.2 - Schematic representation of ship mechanical system's life cycle concept**

### **L.3 Concepts Common to Ship Application Protocols**

ISO 10303-226 is being developed to support the exchange and sharing of Ship Mechanical Systems data. ISO 10303-226 has been developed in conjunction with other ship product application protocols so that important ship related concepts are common and inter-operable within the STEP standard.

#### **L.3.1 Class Type Hierarchy**

The method by which this part of ISO 10303 generalises and integrates the information spanning the domain of a large number of classes (see 3.10.61) is via a hierarchical partitioning commonly known as a type hierarchy. The nature of such a hierarchy is that those objects close to the root of the hierarchy represent the more general objects, while those at the leaves represent the most specialised.

The main components of the type hierarchy employed in this part of ISO 10303 are shown in Figure L.3 for mechanical products. Fundamental to the organisation of the information is the concept of the item (see 3.10.51) within the wider ship APs and the dictionary item within this part of ISO 10303. The dictionary item is a discrete identifiable thing with which properties are associated. It serves as the most general object from which more specialised objects are derived.

The dictionary objects for this part of ISO 10303 are organised in the form of ISO 13584 compliant dictionaries as documented in Annexes M to P.

#### **L.3.2 Definitions Type Hierarchy**

Definitions describe mechanical products and are, as a result, the descriptive information-bearing entities of the model. A definition may be further classified as a physical, functional and so on definition. A mechanical product may have many different versions of definitions. The main components of the definitions type hierarchy employed in this part of ISO 10303 are shown in Figure L.4.

### **L.4 Architecture of the data model**

The main structure of the data model embodied in the ARM of AP226 is characterised as the type hierarchies shown in Figures L.3 and L.4 in which general constructs (e.g. Mechanical Product, Definition) are represented in the ARM. The general constructs references the 10303-226 dictionaries via generalised and flexible referencing mechanisms. This characteristic provides both flexibility and a mechanism by which very specialised constructs (e.g. "diesel\_engines", "RAM\_data" and so on) can be described at implementation level.

In addition to flexibility and the ability to selectively specialise concepts of interest, this structure provides the following advantages;

- The top levels of the hierarchy can be effectively integrated and aligned with the core concepts and facilities common to the entire set of ship-related application protocols, thus providing for the possibility of inter-AP integration.
- The low levels of the hierarchy can be converted into specific constructs to describe specific items of mechanical products (e.g. diesel engine,.....) by referencing to 10303-226 dictionaries.

In dealing with ship mechanical systems, which are effectively a composition of hundreds and thousands of various mechanical products, the approach taken seems to provide a solid basis for capturing all the industrial requirements.

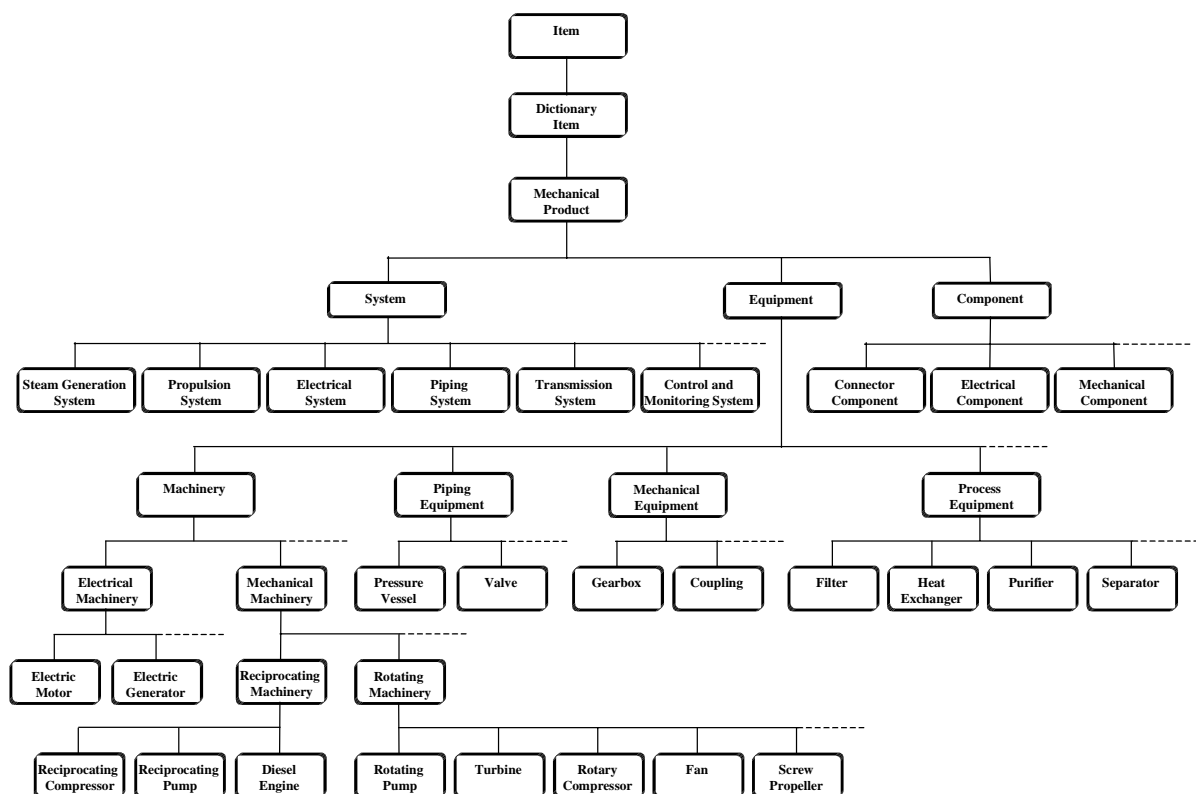


Figure L.3 – AP226 mechanical product type hierarchy

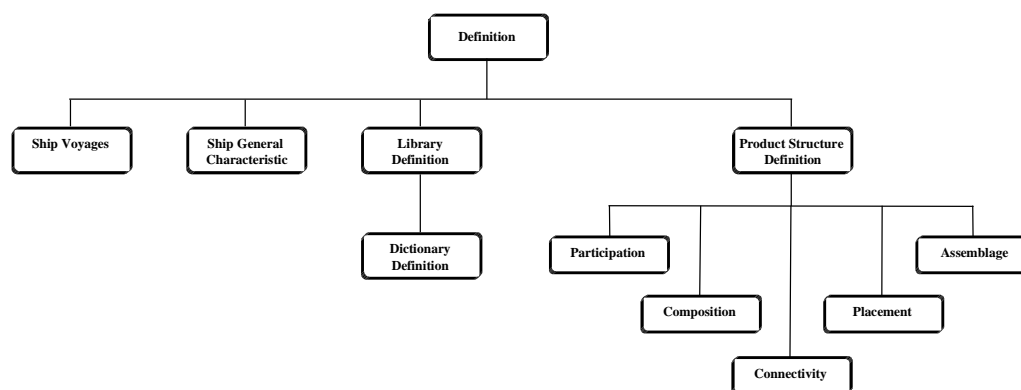


Figure L.4 – AP226 product definition type hierarchy

## L.5 AP226 Data Planning Model

### L.5.1 - What is a data planning model

A data planning model presents all the units of functionality (UoF) together with their major relationships (see Figure L.5). As such, it provides an overview of the Application Reference Model (ARM) without too much detail. It can be used to check whether the different components of the model fit properly together. It is generally agreed that such a data planning model is useful when dealing with complex product models such as those developed within STEP. The data models developed within STEP are documented in EXPRESS and EXPRESS-G and as such are not fully comprehensible to application experts. A data planning model can to some extent overcome this shortcoming.

### L.5.2 Data planning model

Figure L.5 shows the data planning model, representing all the AP226 UoFs. For definition of each UoF, please refer to clause 4.1.

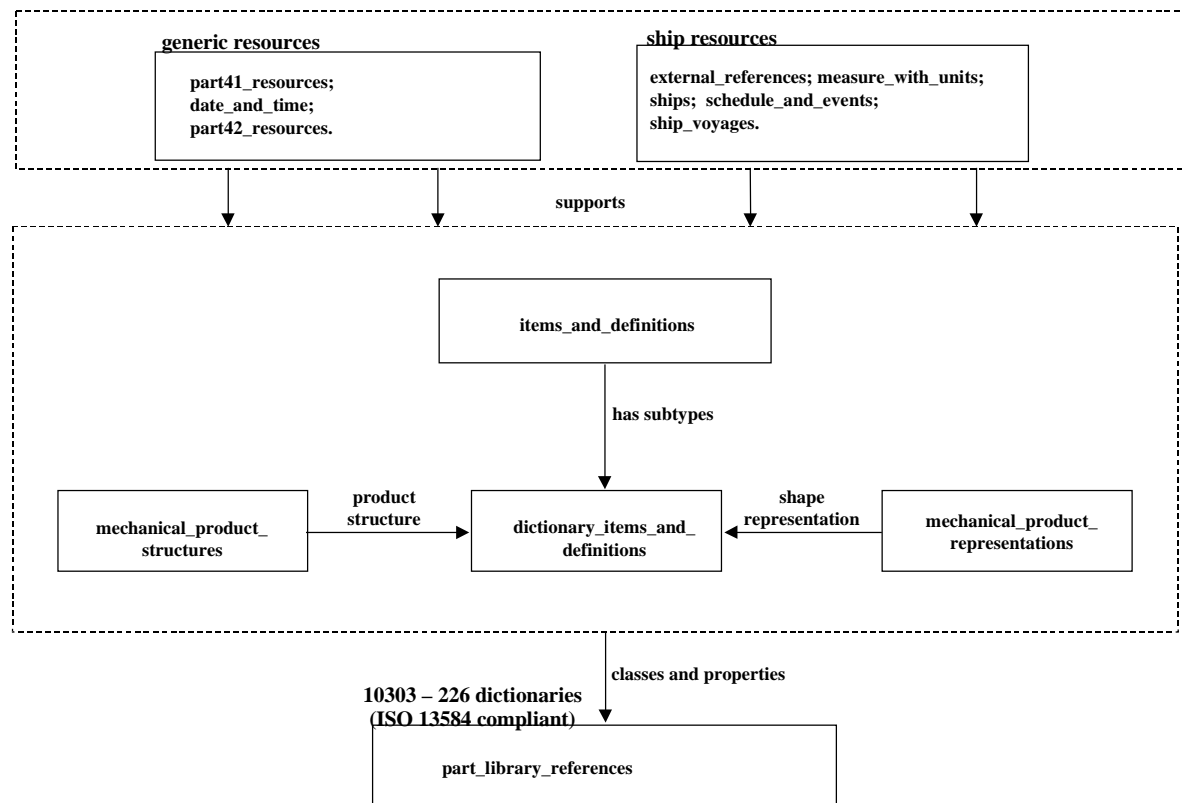


Figure L.5 - AP226 Data Planning Mode



**Annex M**  
**(normative)**  
**ISO 10303 dictionary for class: mechanical products**

## **M.1 Introduction**

The annex specifies a dictionary of classes and properties for mechanical products compatible with ISO 13584-42. The dictionary contains:

- a classification scheme for mechanical products;
- definitions of the classes for mechanical products;
- definitions of the properties for mechanical products.

The collection of classes and properties in this annex form an integral part of this part of ISO 10303. They are meant for use in computerised systems for data exchange as well as component selection and component management, parts list processing and computer-aided design, manufacturing and testing.

### **M.1.1 Sources of information**

The main sources of information contained within this annex are the normative references of this part of ISO 10303 (see 2). Also the dictionaries are according to a previous version of this part of ISO 10303, TC184/SC4/WG3 N793.

### **M.1.2 Notation conventions**

The following graphical rules, as exemplified by class mechanical product, are used in the classification trees in this annex:

- "*mechanical product*" is the name of a class; the definition of the class is given in clause M.3 of this annex.
- "*mechanical product mass*" is the name of a visible property, in the context of ISO 13584-42, that characterises the class "*mechanical product*" (in this case mass of mechanical product). The property definition is given in clause M.4. of this annex. The applicability of this property is defined for each class that "*mechanical product*" is part of its super class hierarchy.

### **M.1.3 Rules**

To construct the dictionary, the following rules are applied:

- the inheritance mechanism is applied to the object properties,
- a class is not used to define a specific valued property of an object,
- a sub-class is introduced when this sub-class defines some specific properties that do not apply to all the instances of the super-class,
- a sub-class is introduced when this sub-class is related to an identified ICS class.

Each class is associated with one class valued property that takes a different value in each of its direct sub-classes. This feature is intended to facilitate class selection during a search process. Using these class valued properties, a set of classes may be selected either by their class codes, or by the values of some value properties.

## **M.1.4 Mechanical product classification principles**

For the classification of components, the principle of dividing the whole set of components into parts has been applied repeatedly, thereby creating a hierarchical tree of several levels of classes. The goal of this classification scheme is to arrange the data element types in an unambiguous-structured way. A detailed description of the classification principles is given in ISO 13584-42.

### **M.1.4.1 Mechanical product class BSU\_code**

A class in ISO 13584 is identified by an BSU\_code. In this dictionary the following structure has been adopted:

"MPC\_NNNNNNNNNN"

in which :

- "MPC" is a prefix characterizing a class identifying a mechanical product object.
- "NNNNNNNNNN" is an extension number used to distinguish the different component class with the same ICS class code.

### **M.1.4.2 Mechanical product class attributes**

The various attributes of the classes in clause M.3 of this annex are explained with the aid of Figure M.1. The layout is shown as used in this part of ISO 10303. For a detailed description of various attributes of the class definition see ISO 13584-42.

		1		8		9		2
		?		?		?		?
L1			MPC_0000000_001	001		01		MPC_0000000_010
L2	3	???????	mechanical product		4	?????		MECHANICAL PRODUCT
L3	7	???????	a ship mechanical product is an individually identifiable mechanical product as defined by AP226.					
L4	5	???????	MPP_0000000_070	mechanical product description				
			?MPP_0000000_071	mechanical product identifier				
			?MPP_0000000_072	mechanical product name				
			?MPP_0000000_073	mechanical product type				
L5	6	???????	MPP_0000000_070	mechanical product description				
			?MPP_0000000_071	mechanical product identifier				
			?MPP_0000000_072	mechanical product name				
			?MPP_0000000_073	mechanical product type				
L6	10	?????????	ISO WD 10303-226 1998(E)					
1	Code (7.2.1) <sup>2</sup>			6	applicable properties (7.2.10) <sup>1</sup>			
2	Super class (7.2.2) <sup>1</sup>			7	Definition (7.2.12) <sup>1</sup>			
3	Preferred name (7.2.3) <sup>1</sup>			8	Version number (7.2.20) <sup>1</sup>			
4	Short name (7.2.4) <sup>1</sup>			9	Revision number (7.2.21) <sup>1</sup>			
5	Visible properties (7.2.9) <sup>1</sup>			10	Source document of definition (7.2.13) <sup>1</sup>			

Figure M.1 - Class specification attributes

### M.1.4.3 Property definitions specification attributes

The various attributes of the property definitions contained in Clause M.4 of this annex are explained with the aid of Figure M.2. For a detailed description of the various attributes of the property definitions see ISO 13583-42.

<sup>2</sup> These clauses refer to the clauses in ISO 13584-42. Other attributes as specified in Clause 7.2 of ISO 13584-42 may be applicable for other definitions.

	1	12	13	11	8	6			
		?			?	?	?	?	?
L1		<b>2304000_PP_003</b>		001	01	?	?	T03	
L2	3	????????????	real_measure_type			NR3..3.ES2	m		
L3	5	???	weight						
L4	4	????	<b>full weight</b>						
L4		?	flooded weight						
L5	7	???	the weight when the component is full of fluid						
L6	9	???	xxxxxxx_PP_002 = specific fluid density (d)						
10	????	fw = (fww - ew) * d + ew							
L7		? ?	where fww is the full water weight, d is the specific fluid density (AAxx002) and ew is the empty weight.						
L8	2	???	23_AA_PCL_0002			14???? ISO*****			
1	Code (6.2.1) <sup>3</sup>			8	Unit (6.2.14) <sup>2</sup>				
2	Definition Class (6.2.2) <sup>2</sup>			9	Condition (6.2.15) <sup>2</sup>				
3	Data type (6.2.3) <sup>2</sup>			10	Formula (6.2.16) <sup>2</sup>				
4	Preferred name / synonymous name (6.2.4) <sup>2</sup>			11	Value format (6.2.17) <sup>2</sup>				
5	Short name (6.2.5) <sup>2</sup>			12	Version number (6.2.21) <sup>2</sup>				
6	Property type classification (6.2.9) <sup>2</sup>			13	Revision number (6.2.21) <sup>2</sup>				
7	Definition (6.2.10) <sup>2</sup>			14	Source document of definition (6.2.10) <sup>2</sup>				

Figure M.2 - Property definition attributes

#### M.1.4.4 Property BSU\_code

A property in ISO 13584 is identified by a BSU\_code. In this dictionary the following structure has been adopted:

"**MPP**\_NNNNNNNNNN"

in which:

- "**MPP**": is a prefix characterizing a property associated to a mechanical product class.
- "NNNNNNNNNN": is an extension number used to distinguish the different properties with the same ICS class code.

<sup>2</sup> These clauses refer to the clauses in ISO 13584-42. Other attributes as specified in Clause 6.2 of ISO 13584-42 may be applicable for other definitions

## M.2 Mechanical product class hierarchy and applicable properties

This subclause defines the class tree and lists the properties under each class.

Item	MPC_0000000000
<i>item_description</i>	<i>MPP_0000000001</i>
<i>item_documentation</i>	<i>MPP_0000000002</i>
<i>item_id</i>	<i>MPP_0000000003</i>
<i>item_ship_context</i>	<i>MPP_0000000004</i>
---mechanical product	MPC_0000000001
<i>mechanical_product_documented_definitions</i>	<i>MPP_0000000012</i>
<i>mechanical_product_material_code</i>	<i>MPP_0000000010</i>
<i>mechanical_product_material_description</i>	<i>MPP_0000000011</i>
<i>mechanical_product_material_name</i>	<i>MPP_0000000009</i>
<i>mechanical_product_the_function</i>	<i>MPP_0000000013</i>
<i>mechanical_product_center_of_gravity</i>	<i>MPP_0000000014</i>
<i>mechanical_product_inertia</i>	<i>MPP_0000000015</i>
<i>mechanical_product_mass</i>	<i>MPP_0000000016</i>
<i>mechanical_product_weight</i>	<i>MPP_0000000017</i>
<i>mechanical_product_standard_name</i>	<i>MPP_0000000006</i>
<i>mechanical_product_task_in_context</i>	<i>MPP_0000000007</i>
<i>mechanical_product_version_id</i>	<i>MPP_0000000008</i>
<i>mechanical_product_overall_breadth</i>	<i>MPP_0000000290</i>
<i>mechanical_product_overall_height</i>	<i>MPP_0000000291</i>
<i>mechanical_product_overall_length</i>	<i>MPP_0000000292</i>
<i>mechanical_product_standard_definition</i>	<i>MPP_0000000005</i>
---system	MPC_0000000112
/ / <i>mechanical_system_functionality</i>	<i>MPP_0000000295</i>
---propulsion system	MPC_0000000113
/ / <i>propulsion_system_type</i>	<i>MPP_0000000307</i>
---mechanical propulsion system	MPC_0000000114
---electric propulsion system	MPC_0000000115
---manoeuvring system	MPC_0000000116
---steam generation system(boiler)	MPC_0000000117
/ / <i>type_of_steam_generation_system</i>	<i>MPP_0000000501</i>
---power generation system	MPC_0000000118
/ / <i>power_generation_system_type</i>	<i>MPP_0000000290</i>
---diesel-electric plant	MPC_0000000119
---shaft-generator system	MPC_0000000120
---steam power plant	MPC_0000000121
---gas turbine plant	MPC_0000000122
---combine cycle plant	MPC_0000000123
---auxiliary system	MPC_0000000124
---piping system	MPC_0000000125
/ / <i>piping_system_type</i>	<i>MPP_0000000296</i>
---ballast system	MPC_0000000126
---bilge water system	MPC_0000000127
---compressed air system	MPC_0000000128
---condensate system	MPC_0000000129
---control air system	MPC_0000000130
---control oil system	MPC_0000000131
---cooling air system	MPC_0000000132
---cooling water system	MPC_0000000133
---engine room ventilation system	MPC_0000000134
---exhaust gas system	MPC_0000000135
---feedwater system	MPC_0000000136
---fire fighting system	MPC_0000000137
---fresh water system	MPC_0000000138
---fuel injection system	MPC_0000000139

			---fuel oil preheating system	MPC_0000000140
			---fuel supply system	MPC_0000000141
			---heeling compensation system	MPC_0000000142
			---intake air system	MPC_0000000143
			---lubrication system	MPC_0000000144
			---pressure water system	MPC_0000000145
			---steam system	MPC_0000000146
			---condition monitoring system	MPC_0000000147
/	/		<i>condition_monitoring_system_type</i>	<i>MPP_0000000595</i>
			---crankcase oil mist detection system	MPC_0000000148
			---control and monitoring system	MPC_0000000149
/	/		<i>type_of_control_and_monitoring_system</i>	<i>MPP_0000000209</i>
			---electrical system	MPC_0000000150
/	/		<i>type_of_electrical_system</i>	<i>MPP_0000000250</i>
			---electrical transmission system	MPC_0000000151
			---mechanical transmission system	MPC_0000000152
			<i>type_of_mechanical_transmission_system</i>	<i>MPP_0000000225</i>
			---starting system	MPC_0000000153
			<i>starting_system_type</i>	<i>MPP_0000000600</i>
			---pneumatic starting system	MPC_0000000154
			---electric starting system	MPC_0000000155
			---manual starting system	MPC_0000000156
			---alarm system	MPC_0000000157
			---data logging system	MPC_0000000158
			---engine control system	MPC_0000000159
			---engine main gear	MPC_0000000160
			---exhaust gas treatment system	MPC_0000000161
			---rudder system	MPC_0000000162
			---safety system	MPC_0000000163
			---steering system	MPC_0000000164
			---steering control mechanism	MPC_0000000165
			---component	MPC_0000000166
			<i>part_of_mechanical_product_component</i>	<i>MPP_0000000288</i>
			---rotating component	MPC_0000000167
			<i>rotating_component_type</i>	<i>MPP_0000000602</i>
			---shaft	MPC_0000000168
			<i>shaft_type</i>	<i>MPP_0000000500</i>
			---flywheel	MPC_0000000169
			---crankshaft	MPC_0000000170
			---bearing	MPC_0000000171
			<i>bearing_type</i>	<i>MPP_0000000202</i>
			---big end bearing	MPC_0000000172
			---main bearing	MPC_0000000173
			---shaft bearing	MPC_0000000174
			---small end bearing	MPC_0000000175
			---camshaft	MPC_0000000176
			---turning gear	MPC_0000000177
			---PTO/PTI assembly	MPC_0000000178
			---gear wheel	MPC_0000000179
			---impeller	MPC_0000000180
			---gear stage	MPC_0000000181
			---process component	MPC_0000000182
			---piping component	MPC_0000000183
			<i>piping_component_type</i>	<i>MPP_0000000299</i>
			---pipe	MPC_0000000184
			<i>pipe_type</i>	<i>MPP_0000000603</i>
			---exhaust pipe	MPC_0000000185
			---fuel line	MPC_0000000186
			---duct	MPC_0000000187
			---expansion joint	MPC_0000000188

				---fitting	MPC_0000000189
				---tunnel	MPC_0000000190
				---discharge duct	MPC_0000000191
				---mechanical component	MPC_0000000192
				<i>mechanical_component_type</i>	MPP_0000000278
				---balance weight	MPC_0000000193
				---brake pad	MPC_0000000194
				---connecting rod	MPC_0000000195
				---crankcase	MPC_0000000196
				---crossshear and guide	MPC_0000000197
				---crossshear pin	MPC_0000000198
				---cylinder	MPC_0000000199
				---cylinder liner	MPC_0000000200
				---drive gear	MPC_0000000201
				---exhaust port	MPC_0000000202
				---exhaust valve	MPC_0000000203
				---fuel injector	MPC_0000000204
				---fuel pump gear	MPC_0000000205
				---gland	MPC_0000000206
				---gudgeon pin	MPC_0000000207
				---guide shores	MPC_0000000208
				---guides	MPC_0000000209
				---inlet valve	MPC_0000000210
				---inspection door	MPC_0000000211
				---intake port	MPC_0000000212
				---manifold	MPC_0000000213
				---intake manifold	MPC_0000000214
				---exhaust manifold	MPC_0000000215
				---piston	MPC_0000000216
				<i>piston_type</i>	MPP_0000000305
				---ring	MPC_0000000217
				---tension rod	MPC_0000000218
				---valve cage	MPC_0000000219
				---valve gear	MPC_0000000220
				---web	MPC_0000000221
				---casing	MPC_0000000222
				---bearing element	MPC_0000000223
				---shaft brake	MPC_0000000224
				---fuel pump	MPC_0000000225
				---rudder	MPC_0000000226
				---electrical component	MPC_0000000227
				<i>electrical_component_type</i>	MPP_0000000605
				---plug	MPC_0000000228
				---electric cable	MPC_0000000229
				---wire	MPC_0000000230
				---lifting component	MPC_0000000231
				---block	MPC_0000000232
				---chain	MPC_0000000233
				---lifting cable	MPC_0000000234
				---lifting eye	MPC_0000000235
				---rope	MPC_0000000236
				---shackle	MPC_0000000237
				---swivel	MPC_0000000238
				---connector component	MPC_0000000239
				<i>connector_component_type</i>	MPP_0000000207
				---structural connector	MPC_0000000240
				<i>structural_connector_type</i>	MPP_0000000505
				---bedplate	MPC_0000000241
				<i>bedplate_type</i>	MPP_0000000301
				---hinge	MPC_0000000242

				---mechanical connector	MPC_0000000243
				---shaft end	MPC_0000000244
				shaft_end_type	MPP_0000000701
				---flanged end	MPC_0000000245
				---welded end	MPC_0000000246
				---keyed end	MPC_0000000247
				---bearing element	MPC_0000000248
				---shaft journal	MPC_0000000249
				---piping connector	MPC_0000000250
				piping_connector_type	MPP_0000000704
				---piping item end	MPC_0000000251
				piping_item_end_type	MPP_0000000606
				---flanged end	MPC_0000000252
				---welded end	MPC_0000000253
				---flared end	MPC_0000000254
				---socketted end	MPC_0000000255
				---electrical connector	MPC_0000000256
				electrical_connector_type	MPP_0000000626
				---cable end	MPC_0000000257
				---socket	MPC_0000000258
				---plug	MPC_0000000259
				---welded end	MPC_0000000260
				---connecting component	MPC_0000000261
				connecting_component_type	MPP_0000000205
				---bolt	MPC_0000000262
				bolt_type	MPP_0000000302
				---chock	MPC_0000000263
				---nut	MPC_0000000264
				---pin	MPC_0000000265
				---rod	MPC_0000000266
				---seal	MPC_0000000267
				---structural-item	MPC_0000000268
				---safety component	MPC_0000000269
				safety_component_type	MPP_0000000710
				---earthing device	MPC_0000000270
				---shaft locking device	MPC_0000000271
				---structural component	MPC_0000000272
				structural_component_type	MPP_0000000720
				---engine block	MPC_0000000273
				---plate	MPC_0000000274
				---profile	MPC_0000000275
				---control component	MPC_0000000276
				---Gage	MPC_0000000277
				---sensor	MPC_0000000278
				---pressure sensor	MPC_0000000279
				---temperature sensor	MPC_0000000280
				---flowrate sensor	MPC_0000000281
				---torque sensor	MPC_0000000282
				---equipment	MPC_0000000002
				equipment_function	MPP_0000000020
				equipment_type_of_duty	MPP_0000000019
				equipment_name_manufacturer_specific	MPP_0000000125
				equipment_name_user_specific	MPP_0000000126
				---control equipment	MPC_0000000080
				control_equipment_type	MPP_0000000211
				---analyser	MPC_0000000081
				analyser_type	MPP_0000000201
				---signal conditioner	MPC_0000000082
				---actuator	MPC_0000000083
				actuator_type	MPP_0000000581



					---pneumatic actuator	MPC_0000000084
					---electric actuator	MPC_0000000085
					---hydraulic actuator	MPC_0000000086
					---manual actuator	MPC_0000000087
					---mechanical equipment	MPC_0000000088
					<i>type_of_mechanical_equipment</i>	<i>MPP_0000000281</i>
					---gear box	MPC_0000000089
					<i>gear_box_type</i>	<i>MPP_0000000252</i>
					---shaft coupling	MPC_0000000090
					<i>coupling_type</i>	<i>MPP_0000000212</i>
					---flexible coupling	MPC_0000000091
					---fluid coupling	MPC_0000000092
					---solid coupling	MPC_0000000093
					---clutch	MPC_0000000094
					---pneumatic clutch	MPC_0000000095
					---hydraulic clutch	MPC_0000000096
					---electro-magnetic clutch	MPC_0000000097
					---silencer	MPC_0000000098
					---mechanical governor	MPC_0000000099
					---damper	MPC_0000000100
					<i>damper_type</i>	<i>MPP_0000000587</i>
					---viscous damper	MPC_0000000101
					---spring-loaded damper	MPC_0000000102
					---electrical equipment	MPC_0000000103
					<i>type_of_electrical_equipment</i>	<i>MPP_0000000245</i>
					---transformer	MPC_0000000104
					---switch board	MPC_0000000105
					---motor starter	MPC_0000000106
					---lifting equipment	MPC_0000000107
					<i>lifting_equipment_lifting_capacity</i>	<i>MPP_0000000100</i>
					<i>lifting_capacity_nature_of_lifting_operation</i>	<i>MPP_0000000101</i>
					<i>lifting_equipment_type</i>	<i>MPP_0000000258</i>
					---crane	MPC_0000000108
					<i>crane_braking_time</i>	<i>MPP_0000000115</i>
					<i>crane_hoisting_speed_1</i>	<i>MPP_0000000116</i>
					<i>crane_hoisting_speed_2</i>	<i>MPP_0000000117</i>
					<i>crane_hoisting_speed_3</i>	<i>MPP_0000000118</i>
					<i>crane_lifting_height</i>	<i>MPP_0000000119</i>
					<i>crane_luffing_time</i>	<i>MPP_0000000120</i>
					<i>crane_slewing_speed_single</i>	<i>MPP_0000000121</i>
					<i>crane_slewing_speed_twin</i>	<i>MPP_0000000122</i>
					<i>crane_overturning_moment</i>	<i>MPP_0000000124</i>
					<i>crane_stability_moment</i>	<i>MPP_0000000123</i>
					<i>crane_jib_parking_arrangements</i>	<i>MPP_0000000113</i>
					<i>crane_forces_due_to_wind</i>	<i>MPP_0000000106</i>
					<i>crane_forces_dynamic</i>	<i>MPP_0000000107</i>
					<i>crane_forces_ship_inclination</i>	<i>MPP_0000000108</i>
					<i>crane_loads_dead</i>	<i>MPP_0000000109</i>
					<i>crane_loads_live</i>	<i>MPP_0000000110</i>
					<i>crane_loads_on_platform</i>	<i>MPP_0000000111</i>
					<i>crane_loads_snow_and_ice</i>	<i>MPP_0000000112</i>
					<i>crane_jib_angle_max</i>	<i>MPP_0000000102</i>
					<i>crane_jib_angle_min</i>	<i>MPP_0000000103</i>
					<i>crane_jib_radius_max</i>	<i>MPP_0000000104</i>
					<i>crane_jib_radius_min</i>	<i>MPP_0000000105</i>
					<i>crane_type</i>	<i>MPP_0000000213</i>
					<i>crane_ambient-condition_wind_speed</i>	<i>MPP_0000000215</i>
					---deck_crane	MPC_0000000109
					---derrick	MPC_0000000110
					---winch	MPC_0000000111

---	machinery	MPC_000000003
	<i>machinery_design_point_description</i>	<i>MPP_0000000023</i>
	<i>machinery_design_efficiency</i>	<i>MPP_0000000024</i>
	<i>machinery_design_power</i>	<i>MPP_0000000025</i>
	<i>machinery_overload_characteristics</i>	<i>MPP_0000000026</i>
	<i>machinery_power_maximum</i>	<i>MPP_0000000029</i>
	<i>machinery_rotational_speed_maximum</i>	<i>MPP_0000000027</i>
	<i>machinery_rotational_speed_minimum</i>	<i>MPP_0000000028</i>
	<i>machinery_direction_of_rotation</i>	<i>MPP_0000000030</i>
	<i>machinery_lube_oil_system_type</i>	<i>MPP_0000000031</i>
	<i>machinery_accumulated_revolution_counter</i>	<i>MPP_0000000032</i>
	<i>machinery_accumulated_shaft_energy</i>	<i>MPP_0000000033</i>
	<i>machinery_ambient_pressure_maximum</i>	<i>MPP_0000000267</i>
	<i>machinery_ambient_pressure_minimum</i>	<i>MPP_0000000268</i>
	<i>machinery_ambient_temperature_maximum</i>	<i>MPP_0000000269</i>
	<i>machinery_ambient_temperature_minimum</i>	<i>MPP_0000000270</i>
	<i>machinery_type</i>	<i>MPP_0000000265</i>
	<i>machinery_operating_point_description</i>	<i>MPP_0000000271</i>
	<i>machinery_operating_efficiency</i>	<i>MPP_0000000272</i>
	<i>machinery_operating_power</i>	<i>MPP_0000000273</i>
	<i>machinery_design_rotational_speed</i>	<i>MPP_0000000274</i>
	<i>machinery_operating_rotational_speed</i>	<i>MPP_0000000277</i>
---	mechanical machinery	MPC_000000004
	<i>mechanical_machinery_type</i>	<i>MPP_0000000285</i>
---	reciprocating machinery	MPC_000000005
	<i>reciprocating_machinery_cylinder_cooling_method</i>	<i>MPP_0000000034</i>
	<i>reciprocating_machinery_compression_ratio</i>	<i>MPP_0000000037</i>
	<i>reciprocating_machinery_cylinder_bore</i>	<i>MPP_0000000036</i>
	<i>reciprocating_machinery_piston_stroke</i>	<i>MPP_0000000035</i>
	<i>reciprocating_machinery_type</i>	<i>MPP_0000000309</i>
	<i>reciprocating_machinery_no_of_cylinders</i>	<i>MPP_0000000310</i>
---	diesel engine	MPC_000000006
	<i>diesel_engine_piston_speed</i>	<i>MPP_0000000068</i>
	<i>diesel_engine_charge_cooler_arrangement</i>	<i>MPP_0000000053</i>
	<i>diesel_engine_cylinder_configuration</i>	<i>MPP_0000000054</i>
	<i>diesel_engine_cycle</i>	<i>MPP_0000000055</i>
	<i>diesel_engine_firing_angle</i>	<i>MPP_0000000056</i>
	<i>diesel_engine_firing_interval</i>	<i>MPP_0000000057</i>
	<i>diesel_engine_firing_order</i>	<i>MPP_0000000058</i>
	<i>diesel_engine_fuel_injection_system_type</i>	<i>MPP_0000000059</i>
	<i>diesel_engine_fuel_oil_system_type</i>	<i>MPP_0000000060</i>
	<i>diesel_engine_fuel_type</i>	<i>MPP_0000000061</i>
	<i>diesel_engine_piston_guide_type</i>	<i>MPP_0000000062</i>
	<i>diesel_engine_pressure_charging_system</i>	<i>MPP_0000000063</i>
	<i>diesel_engine_reversibility</i>	<i>MPP_0000000064</i>
	<i>diesel_engine_starting_system_method</i>	<i>MPP_0000000065</i>
	<i>diesel_engine_turbocharger_type</i>	<i>MPP_0000000066</i>
	<i>diesel_engine_vee_angle</i>	<i>MPP_0000000067</i>
	<i>diesel_engine_brake_mean_effective_pressure</i>	<i>MPP_0000000038</i>
	<i>diesel_engine_brake_power</i>	<i>MPP_0000000039</i>
	<i>diesel_engine_brake_specific_fuel_consumption</i>	<i>MPP_0000000041</i>
	<i>diesel_engine_brake_torque</i>	<i>MPP_0000000040</i>
	<i>diesel_engine_cooling_water_flow_rate</i>	<i>MPP_0000000042</i>
	<i>diesel_engine_cooling_water_fluid_pressure</i>	<i>MPP_0000000043</i>
	<i>diesel_engine_cooling_water_fluid_temperature</i>	<i>MPP_0000000044</i>
	<i>diesel_engine_exhaust_nitrogen_oxide</i>	<i>MPP_0000000045</i>
	<i>diesel_engine_exhaust_particulates</i>	<i>MPP_0000000046</i>
	<i>diesel_engine_exhaust_smoke</i>	<i>MPP_0000000047</i>
	<i>diesel_engine_exhaust_sulphur_oxides</i>	<i>MPP_0000000048</i>
	<i>diesel_engine_exhaust_unburnt_hydrocarbons</i>	<i>MPP_0000000049</i>

					<i>diesel_engine_indicated_mean_effective_pressure</i>	<i>MPP_0000000050</i>
					<i>diesel_engine_maximum_cylinder_pressure</i>	<i>MPP_0000000051</i>
					<i>diesel_engine_shaft_revolution_counter</i>	<i>MPP_0000000052</i>
					<i>diesel_engine_lube_oil_flowrate</i>	<i>MPP_0000000240</i>
					<i>diesel_engine_lube_oil_fluid_pressure</i>	<i>MPP_0000000241</i>
					<i>diesel_engine_lube_oil_fluid_temperature</i>	<i>MPP_0000000242</i>
					---spark ignition engine	MPC_0000000007
					---reciprocating compressor	MPC_0000000008
					---reciprocating pump	MPC_0000000009
					---fuel injection pump	MPC_0000000010
					---steam engine	MPC_0000000011
					---rotating machinery	MPC_0000000012
					<i>rotating_machinery_type</i>	<i>MPP_0000000220</i>
					---pump propulsor	MPC_0000000013
					---screw propeller	MPC_0000000014
					<i>screw_propeller_max_ahead_pitch</i>	<i>MPP_0000000075</i>
					<i>screw_propeller_max_astern_pitch</i>	<i>MPP_0000000076</i>
					<i>screw_propeller_fit_of_hub_to_shaft</i>	<i>MPP_0000000086</i>
					<i>screw_propeller_hub_type</i>	<i>MPP_0000000085</i>
						<i>MPP_0000000084</i>
					<i>screw_propeller_pitch_control_mechanism_description</i>	
					<i>screw_propeller_type_by_blade_outline</i>	<i>MPP_0000000083</i>
					<i>screw_propeller_type_by_design_configuration</i>	<i>MPP_0000000082</i>
					<i>screw_propeller_type_by_duct</i>	<i>MPP_0000000081</i>
					<i>screw_propeller_type_of_pitch</i>	<i>MPP_0000000080</i>
					<i>screw_propeller_type_of_construction</i>	<i>MPP_0000000079</i>
						<i>MPP_0000000088</i>
					<i>screw_propeller_entrained_water_method_of_calculation</i>	
					<i>screw_propeller_inertia_in_water</i>	<i>MPP_0000000089</i>
					<i>screw_propeller_weight_including_water</i>	<i>MPP_0000000090</i>
/					<i>screw_propeller_immersion_in_ballast_condition</i>	<i>MPP_0000000078</i>
					<i>screw_propeller_immersion_in_loaded_condition</i>	<i>MPP_0000000077</i>
					<i>screw_propeller_opearing_rotational_speed</i>	<i>MPP_0000000099</i>
					<i>screw_propeller_design_pitch</i>	<i>MPP_0000000069</i>
					<i>screw_propeller_blade_area_ratio_expanded</i>	<i>MPP_0000000091</i>
					<i>screw_propeller_blade_thickness_at_centerline</i>	<i>MPP_0000000092</i>
					<i>screw_propeller_diameter</i>	<i>MPP_0000000093</i>
					<i>screw_propeller_hub_to_diameter_ratio</i>	<i>MPP_0000000094</i>
					<i>screw_propeller_mean_pitch_diameter_ratio</i>	<i>MPP_0000000095</i>
						<i>MPP_0000000096</i>
					<i>screw_propeller_nominal_design_pitch_diameter_ratio</i>	
					<i>screw_propeller_rake_angle</i>	<i>MPP_0000000097</i>
					<i>screw_propeller_shaft_height</i>	<i>MPP_0000000098</i>
					<i>screw_propeller_skew_angle</i>	<i>MPP_0000000087</i>
					<i>screw_propeller_tip_clearnce_to_hull</i>	<i>MPP_0000000074</i>
					<i>screw_propeller_type</i>	<i>MPP_0000000330</i>
					<i>screw_propeller_design_rotational_speed</i>	<i>MPP_0000000350</i>
					<i>screw_propeller_design_power</i>	<i>MPP_0000000343</i>
					<i>screw_propeller_design_point_description</i>	<i>MPP_0000000341</i>
					<i>screw_propeller_design_efficiency</i>	<i>MPP_0000000340</i>
					<i>screw_propeller_number_of_blades</i>	<i>MPP_0000000333</i>
					---cycloidal propeller	MPC_0000000015
					---steam turbine	MPC_0000000016
					---gas turbine	MPC_0000000017
					---rotary compressor	MPC_0000000018
					---fan	MPC_0000000019
					---turbocharger	MPC_0000000020
					---supercharger	MPC_0000000021
					---power turbine	MPC_0000000022
					---azimuth propulsor	MPC_0000000023

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					---soleroid valve	MPC_0000000066
					---ball float valve	MPC_0000000067
					---poppet valve	MPC_0000000068
					---relief valve	MPC_0000000069
					---dish valve	MPC_0000000070

### M.3 Mechanical product classes definition

<b>MPC_0000000056</b>	001	001	<b>MPC_0000000055</b>
<b>valve</b>		<b>valve</b>	
a piping equipment that is used for controlling fluid flow though the piping system			
MPP_0000000555	valve_type		
MPP_0000000300	piping_equipment_type		
MPP_0000000020	equipment_function		
MPP_0000000019	equipment_type_of_duty		
MPP_0000000125	equipment_name_manufacturer_specific		
MPP_0000000126	equipment_name_user_specific		
MPP_0000000012	mechanical_product_documented_definitions		
MPP_0000000010	mechanical_product_material_code		
MPP_0000000011	mechanical_product_material_description		
MPP_0000000009	mechanical_product_material_name		
MPP_0000000013	mechanical_product_the_function		
MPP_0000000014	mechanical_product_center_of_gravity		
MPP_0000000015	mechanical_product_inertia		
MPP_0000000016	mechanical_product_mass		
MPP_0000000017	mechanical_product_weight		
MPP_0000000006	mechanical_product_standard_name		
MPP_0000000007	mechanical_product_task_in_context		
MPP_0000000008	mechanical_product_version_id		
MPP_0000000290	mechanical_product_overall_breadth		
MPP_0000000291	mechanical_product_overall_height		
MPP_0000000292	mechanical_product_overall_length		
MPP_0000000005	mechanical_product_standard_definition		
MPP_0000000001	item_description		
MPP_0000000002	item_documentation		
MPP_0000000003	item_id		
MPP_0000000004	item_ship_context		

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<b>MPC_0000000055</b>	001	001	<b>MPC_0000000002</b>
<b>piping equipment</b>			
a non-machinery equipment that is primarily used in a piping system			
MPP_0000000300	piping_equipment_type		
MPP_0000000020	equipment_function		
MPP_0000000019	equipment_type_of_duty		
MPP_0000000125	equipment_name_manufacturer_specific		
MPP_0000000126	equipment_name_user_specific		
MPP_0000000012	mechanical_product_documented_definitions		
MPP_0000000010	mechanical_product_material_code		
MPP_0000000011	mechanical_product_material_description		
MPP_0000000009	mechanical_product_material_name		
MPP_0000000013	mechanical_product_the_function		
MPP_0000000014	mechanical_product_center_of_gravity		
MPP_0000000015	mechanical_product_inertia		
MPP_0000000016	mechanical_product_mass		
MPP_0000000017	mechanical_product_weight		
MPP_0000000006	mechanical_product_standard_name		
MPP_0000000007	mechanical_product_task_in_context		
MPP_0000000008	mechanical_product_version_id		
MPP_0000000290	mechanical_product_overall_breadth		
MPP_0000000291	mechanical_product_overall_height		
MPP_0000000292	mechanical_product_overall_length		
MPP_0000000005	mechanical_product_standard_definition		

MPP_000000001	item_description
MPP_000000002	item_documentation
MPP_000000003	item_id
MPP_000000004	item_ship_context

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<b>MPC_000000054</b>	001	001	MPC_000000035
<b>ejector</b>			
Not clearly defined ISO TC184/SC4/WG3 N730			
MPP_000000304	process_equipment_type		
MPP_000000020	equipment_function		
MPP_000000019	equipment_type_of_duty		
MPP_000000125	equipment_name_manufacturer_specific		
MPP_000000126	equipment_name_user_specific		
MPP_000000012	mechanical_product_documented_definitions		
MPP_000000010	mechanical_product_material_code		
MPP_000000011	mechanical_product_material_description		
MPP_000000009	mechanical_product_material_name		
MPP_000000013	mechanical_product_the_function		
MPP_000000014	mechanical_product_center_of_gravity		
MPP_000000015	mechanical_product_inertia		
MPP_000000016	mechanical_product_mass		
MPP_000000017	mechanical_product_weight		
MPP_000000006	mechanical_product_standard_name		
MPP_000000007	mechanical_product_task_in_context		
MPP_000000008	mechanical_product_version_id		
MPP_000000290	mechanical_product_overall_breadth		
MPP_000000291	mechanical_product_overall_height		
MPP_000000292	mechanical_product_overall_length		
MPP_000000005	mechanical_product_standard_definition		
MPP_000000001	item_description		
MPP_000000002	item_documentation		
MPP_000000003	item_id		
MPP_000000004	item_ship_context		

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<b>MPC_000000053</b>	001	001	MPC_000000035
<b>De-oiler</b>			
Not clearly defined ISO TC184/SC4/WG3 N730			
MPP_000000304	process_equipment_type		
MPP_000000020	equipment_function		
MPP_000000019	equipment_type_of_duty		
MPP_000000125	equipment_name_manufacturer_specific		
MPP_000000126	equipment_name_user_specific		
MPP_000000012	mechanical_product_documented_definitions		
MPP_000000010	mechanical_product_material_code		
MPP_000000011	mechanical_product_material_description		
MPP_000000009	mechanical_product_material_name		
MPP_000000013	mechanical_product_the_function		
MPP_000000014	mechanical_product_center_of_gravity		
MPP_000000015	mechanical_product_inertia		
MPP_000000016	mechanical_product_mass		
MPP_000000017	mechanical_product_weight		
MPP_000000006	mechanical_product_standard_name		
MPP_000000007	mechanical_product_task_in_context		
MPP_000000008	mechanical_product_version_id		
MPP_000000290	mechanical_product_overall_breadth		
MPP_000000291	mechanical_product_overall_height		
MPP_000000292	mechanical_product_overall_length		
MPP_000000005	mechanical_product_standard_definition		
MPP_000000001	item_description		
MPP_000000002	item_documentation		
MPP_000000003	item_id		
MPP_000000004	item_ship_context		

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<b>MPC_000000052</b>	001	001	MPC_000000035
<b>De-aerator</b>			
Not clearly defined ISO TC184/SC4/WG3 N730			
MPP_000000304	process_equipment_type		
MPP_000000020	equipment_function		
MPP_000000019	equipment_type_of_duty		
MPP_000000125	equipment_name_manufacturer_specific		
MPP_000000126	equipment_name_user_specific		
MPP_000000012	mechanical_product_documented_definitions		
MPP_000000010	mechanical_product_material_code		
MPP_000000011	mechanical_product_material_description		
MPP_000000009	mechanical_product_material_name		
MPP_000000013	mechanical_product_the_function		
MPP_000000014	mechanical_product_center_of_gravity		
MPP_000000015	mechanical_product_inertia		
MPP_000000016	mechanical_product_mass		
MPP_000000017	mechanical_product_weight		
MPP_000000006	mechanical_product_standard_name		
MPP_000000007	mechanical_product_task_in_context		
MPP_000000008	mechanical_product_version_id		
MPP_000000290	mechanical_product_overall_breadth		
MPP_000000291	mechanical_product_overall_height		
MPP_000000292	mechanical_product_overall_length		
MPP_000000005	mechanical_product_standard_definition		
MPP_000000001	item_description		
MPP_000000002	item_documentation		
MPP_000000003	item_id		
MPP_000000004	item_ship_context		

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<b>MPC_000000051</b>	001	001	MPC_000000035
<b>condenser</b>			
Not clearly defined ISO TC184/SC4/WG3 N730			
MPP_000000304	process_equipment_type		
MPP_000000020	equipment_function		
MPP_000000019	equipment_type_of_duty		
MPP_000000125	equipment_name_manufacturer_specific		
MPP_000000126	equipment_name_user_specific		
MPP_000000012	mechanical_product_documented_definitions		
MPP_000000010	mechanical_product_material_code		
MPP_000000011	mechanical_product_material_description		
MPP_000000009	mechanical_product_material_name		
MPP_000000013	mechanical_product_the_function		
MPP_000000014	mechanical_product_center_of_gravity		
MPP_000000015	mechanical_product_inertia		
MPP_000000016	mechanical_product_mass		
MPP_000000017	mechanical_product_weight		
MPP_000000006	mechanical_product_standard_name		
MPP_000000007	mechanical_product_task_in_context		
MPP_000000008	mechanical_product_version_id		
MPP_000000290	mechanical_product_overall_breadth		
MPP_000000291	mechanical_product_overall_height		
MPP_000000292	mechanical_product_overall_length		
MPP_000000005	mechanical_product_standard_definition		
MPP_000000001	item_description		
MPP_000000002	item_documentation		
MPP_000000003	item_id		
MPP_000000004	item_ship_context		

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<b>MPC_000000050</b>	001	001	MPC_000000040
<b>water heater</b>			
Not clearly defined ISO TC184/SC4/WG3 N730			
MPP_000000255	heat_exchanger_role		
MPP_000000256	heat_exchanger_type		
MPP_000000304	process_equipment_type		

MPP_0000000020	equipment_function
MPP_0000000019	equipment_type_of_duty
MPP_0000000125	equipment_name_manufacturer_specific
MPP_0000000126	equipment_name_user_specific
MPP_0000000012	mechanical_product_documented_definitions
MPP_0000000010	mechanical_product_material_code
MPP_0000000011	mechanical_product_material_description
MPP_0000000009	mechanical_product_material_name
MPP_0000000013	mechanical_product_the_function
MPP_0000000014	mechanical_product_center_of_gravity
MPP_0000000015	mechanical_product_inertia
MPP_0000000016	mechanical_product_mass
MPP_0000000017	mechanical_product_weight
MPP_0000000006	mechanical_product_standard_name
MPP_0000000007	mechanical_product_task_in_context
MPP_0000000008	mechanical_product_version_id
MPP_0000000290	mechanical_product_overall_breadth
MPP_0000000291	mechanical_product_overall_height
MPP_0000000292	mechanical_product_overall_length
MPP_0000000005	mechanical_product_standard_definition
MPP_0000000001	item_description
MPP_0000000002	item_documentation
MPP_0000000003	item_id
MPP_0000000004	item_ship_context

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## M.4 Mechanical product properties definitions

<b>MPP_0000000300</b>	001	001	A52
string		A..0	
<p>           piping_equipment_type            piping_equipment_type            type of piping equipment         </p>			
MPC_0000000055		ISO/WD 10303-226(E)(4.2.139)	
PRL TAK TAK VAE UDPET		pressure_vessel tank tank valve user_defined_piping_equipment_type	

<b>MPP_0000000256</b>	001	001	A52
string		A..0	
<p>           heat_exchanger_type            heat_exchanger_type            type of heat exchanger based on its contruction         </p>			
MPC_0000000040		ISO/WD 10303-226(E)(4.2.71.2)	
STCOF STCRF STPAF UDHET		shell_and_tube_counter_flow shell_and_tube_cross_flow shell_and_tube_parallel_flow user_defined_heat_exchanger_role	

<b>MPP_0000000255</b>	001	001	A52
string		A..0	
<p>           heat_exchanger_role            heat_exchanger_role            function of heat exchanger         </p>			
WAR WAH UDHET		water_cooler water_heater user_defined_heat_exchanger_role	



<b>MPP_0000000576</b>	001	001	A..0	A52
string				
filter_type				
filter_type				
type of filter				
MPC_0000000036		ISO/WD 10303-226(E)()		
AIFL		air_filter		
FUFL		fuel_filter		
LUFL		lube_oil_filter		
<b>MPP_0000000304</b>	001	001	A..0	A52
string				
process_equipment_type				
process_equipment_type				
type of process equipment				
MPC_0000000035		ISO/WD 10303-226(E)(4.2.145)		
FITR		filter		
HEER		heat_exchanger		
CODR		condenser		
DELR		de-oiler		
DETR		de-aerator		
EJTR		ejector		
<b>MPP_0000000575</b>	001	001	A..0	A52
string				
process_machinery_type				
process_machinery_type				
type of process machinery				
MPC_0000000028		ISO/WD 10303-226(E)()		
AGTR		agitator		
CEFG		centrifuge		
SETR		separator		
PUFR		purifier		
HOGH		homogeniser		
CLFR		clarifier		
<b>MPP_0000000525</b>	001	001	A..0	A52
string				
electrical_machinery_type				
electrical_machinery_type				
type of electrical machinery				
MPC_0000000025		ISO/WD 10303-226(E)()		
ELMR		electric_motor		
ELGR		electric_generator		
<b>MPP_0000000350</b>	001	001	NR1..0	A79
integer				
rotational_speed				
screw_propeller_design_rotational_speed				
designed rotational speed of the screw propeller at the operating point				
MPC_0000000014		ISO/WD 10303-226(E)(4.2.126.4)		
<b>MPP_0000000343</b>	001	001	NR2..0.3	K27
real_measure_type			watt	

design\_power  
screw\_propeller\_design\_power  
designed power of the screw propeller at the operating point

MPC\_0000000014

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## **M.5 Machine readable library file**

This subclause contains a library file, compliant with ISO 13584-42, containing the complete 10303-226 dictionary for this class. The dictionary includes the class hierarchy, class definition, and property definitions contained in subclauses M.2, M.3 and M.4 of this annex. This clause is supplied in machine readable form only. It may be found on the STEP on-line information system (SOLIS), ISO 10303 – AP226 area (to be added).

Annex N  
(normative)  
ISO 10303 dictionary for class: tasks

N.1 Introduction

The clause M.1 in annex M applies here.

N.2 Task class hierarchy and applicable properties

This subclause defines the class tree and lists the properties under each class. To be completed at a later date.

Item	MPC_0000000000
item_description	MPP_0000000001
item_documentation	MPP_0000000002
item_id	MPP_0000000003
---task	TAC_0000000001
task_job_number	TAP_00000000

N.3 Task classes definition

To be completed at a later date.

TAC_0000000001	001	001	MPC_0000000055
task			
an activity that is intended to be carried out on a mechanical product			
TAP_0000000001	task_job_number		
MPP_0000000001	item_description		
MPP_0000000002	item_documentation		
MPP_0000000003	item_id		

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N.4 Task properties definitions

To be completed at a later date.

TAP_0000000001	001	001	A52
string		A..0	
job_number			

MPC\_0000000055 ISO/WD 10303-226(E)(4.2.139)

M.5Machine readable library file

This subclause contains a library file, compliant with ISO 13584-42 containing the complete 10303-226 dictionary for this class. To be completed later on.

**Annex O**  
(normative)  
**ISO 10303 dictionary for class: product anomalies**

**O.1 Introduction**

The clause M.1 in annex M applies here.

**O.2 Product anomaly class hierarchy and applicable properties**

This subclause defines the class tree and lists the properties under each class. *To be completed at a later date.*

Item	MPC_0000000000
item_description	MPP_0000000001
item_documentation	MPP_0000000002
item_id	MPP_0000000003
---Product Anomaly	PAC_0000000001
date_happened	PAP_0000000001
date_discovered	PAP_0000000002
date_rectified	PAP_0000000003

**O.3 Product anomaly classes definition**

*To be completed at a later date.*

<b>PAC_0000000001</b>	001	001	MPC_0000000055
<b>Product anomaly</b>			
A product problem or enhancement that may result in a change management			
<b>PAP_0000000001</b>	<b>date_happened</b>		
<b>PAP_0000000002</b>	<b>date_discovered</b>		
<b>PAP_0000000003</b>	<b>date_rectified</b>		
<b>MPP_0000000001</b>	<b>item_description</b>		
<b>MPP_0000000002</b>	<b>item_documentation</b>		
<b>MPP_0000000003</b>	<b>item_id</b>		

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**O.4 Product anomaly properties definitions**

*To be completed at a later date.*

<b>PAP_0000000001</b>	001	001	A52
string		A..0	
date_happened			

MPC\_0000000055                      ISO/WD 10303-226(E)(4.2.139)

**O.5 Machine readable library file**

This subclause contains a library file, compliant with ISO 13584-42 containing the complete 10303-226 dictionary for this class. *To be completed later on.*

## Annex P

(normative)

### ISO 10303 dictionary for class: materials

#### P.1 Introduction

The clause M.1 in annex M applies here.

#### P.2 Material class hierarchy and applicable properties

This subclause defines the class tree and lists the properties under each class. *To be completed at a later date.*

material	MTLC_000000001
density	MTLP_000000004
heat_capacity	MTLP_000000005
material_code	MTLP_000000006
material_name	MTLP_000000007
thermal_conductivity	MTLP_000000008
element_content_percent	MTLP_000000038
element_name	MTLP_000000037
impurity_content_percentage	MTLP_000000040
impurity_name	MTLP_000000039
material_type	MTLP_000000044
impurity_type	MTLP_000000047
heating_value	MTLP_000000014
ignition_temperature	MTLP_000000015
mean_molecular_weight	MTLP_000000018
reference_pressure	MTLP_000000019
reference_temperature	MTLP_000000020
---fluid_material	MTLC_000000002
fluid_material_type	MTLP_000000045
viscosity	MTLP_000000022
---gas_material	MTLC_000000012
gas_material_type	MTLP_000000046
---steam	MTLC_000000021
---exhaust_gas	MTLC_000000010
---air	MTLC_000000009
---liquid_material	MTLC_000000016
liquid_material_type	MTLP_000000046
---water	MTLC_000000023
---lubrication_oil	MTLC_000000017
---gas_oil	MTLC_000000013
---fuel_oil	MTLC_000000011
---solid_material	MTLC_000000003
corrosion_fatigue_strength	MTLP_000000025
elongation	MTLP_000000026
fatigue_strength	MTLP_000000027
hardness	MTLP_000000028
poisson_ratio	MTLP_000000030
shear_modulus	MTLP_000000031
solid_material_type	MTLP_000000047
stress_of_fracture	MTLP_000000032
thermal_expansion_coefficient	MTLP_000000033
ultimate_tensile_stress	MTLP_000000034
yield_point	MTLP_000000035
youngs_modulus	MTLP_000000036

	---coal	MTLC_000000024
	---metal	MTLC_000000029

### P.3 Material classes definitions

MTLC_000000029	001	001	MTLC_000000003
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metal  
specifies that the solid\_material is a metal

MTLP_000000025	corrosion_fatigue_strength
MTLP_000000026	elongation
MTLP_000000027	fatigue_strength
MTLP_000000028	hardness
MTLP_000000030	poisson_ratio
MTLP_000000031	shear_modulus
MTLP_000000047	solid_material_type
MTLP_000000032	stress_of_fracture
MTLP_000000033	thermal_expansion_coefficient
MTLP_000000034	ultimate_tensile_stress
MTLP_000000035	yield_point
MTLP_000000036	youngs_modulus
MTLP_000000004	density
MTLP_000000005	heat_capacity
MTLP_000000006	material_code
MTLP_000000007	material_name
MTLP_000000008	thermal_conductivity
MTLP_000000038	element_content_percent
MTLP_000000037	element_name
MTLP_000000040	impurity_content_percentage
MTLP_000000039	impurity_name
MTLP_000000044	material_type
MTLP_000000047	impurity_type
MTLP_000000014	heating_value
MTLP_000000015	ignition_temperature
MTLP_000000018	mean_molecular_weight
MTLP_000000019	reference_pressure
MTLP_000000020	reference_temperature

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### P.4 Material class properties definitions

MTLP_000000047	001	001	A57
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string                      A..0

solid\_material\_type  
designates the specific type of solid\_material

MTLC\_000000003 ISO/WD 10303-226 N793 (modified by CTC)

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MTLP_000000031	001	001	K18
real	NR2..0.0		
shear_modulus			
the strength factor for the material under shear stress			
MTLC_000000003	ISO/WD 10303-226 N793 (modified by CTC)		
<hr/>			
MTLP_000000036	001	001	K18
real	NR2..0.0		
youngs_modulus			
is the ratio between stress and strain in the elastic region			
MTLC_000000003	ISO/WD 10303-226 N793		
<hr/>			
MTLP_000000035	001	001	K15
real	NR2..0.0		
yield_point			
defines the limit to elastic deformation beyond which the material undergoes plastic deformation			
MTLC_000000003	ISO/WD 10303-226 N793 (modified by CTC)		
<hr/>			

**P.5 Machine readable library file**

This subclause contains a library file, compliant with ISO 13584-42 containing the complete 10303-226 dictionary of this class. *To be completed later on.*

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